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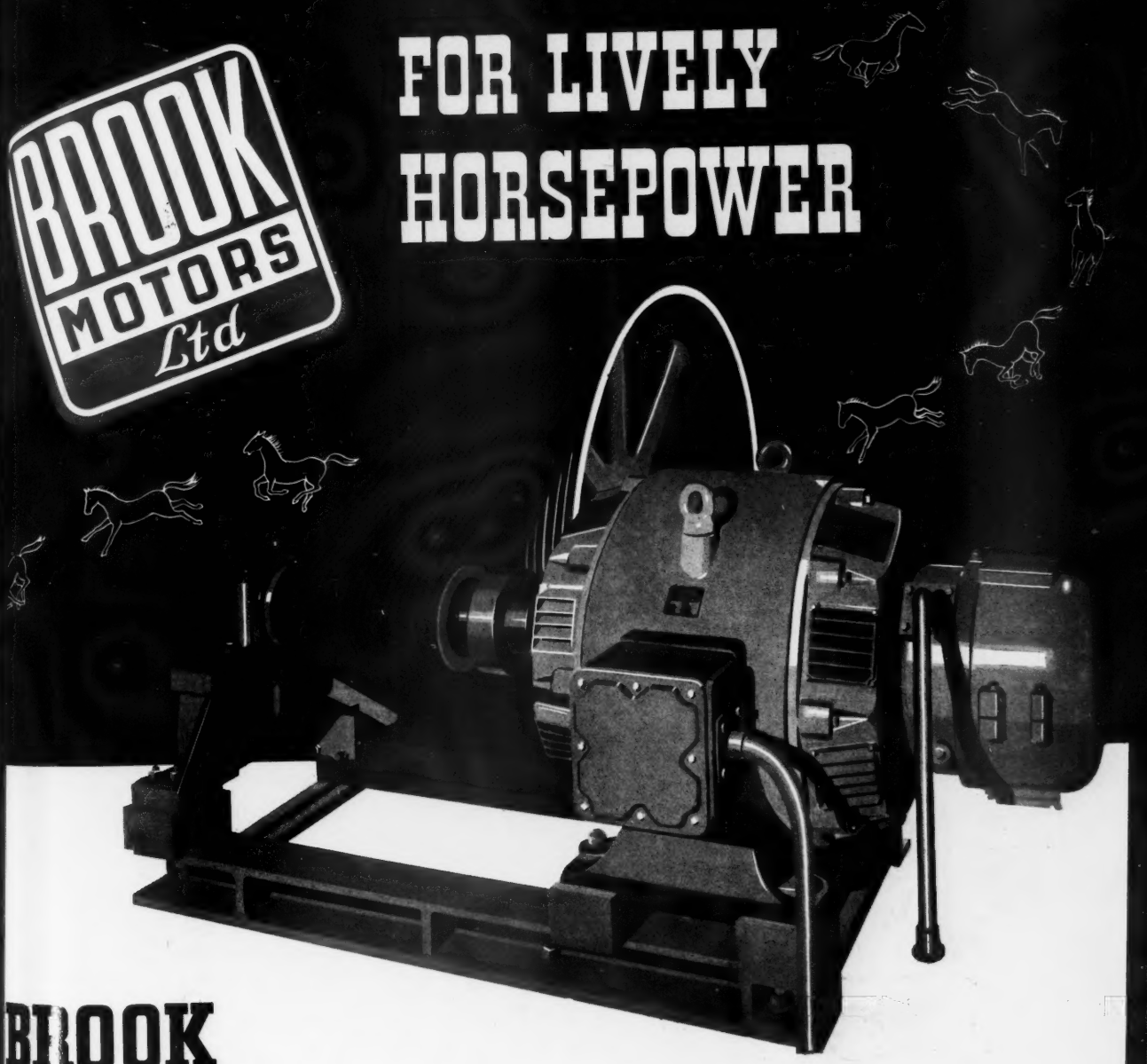

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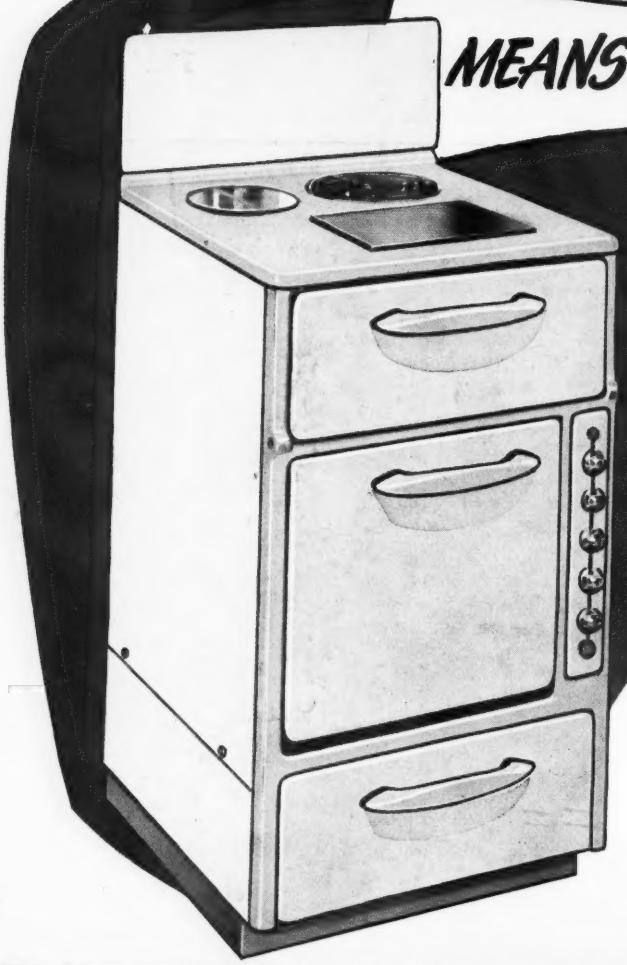

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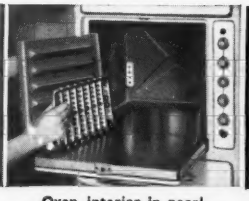
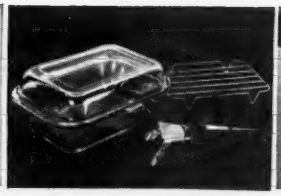
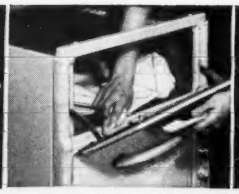


Oven interior in pearl-grey vitreous enamel which cleans quickly and easily.



Pyrex glass casserole becomes a grill pan when used with the patent handle grip.



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ELECTRICAL REVIEW

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19 AUGUST 1955

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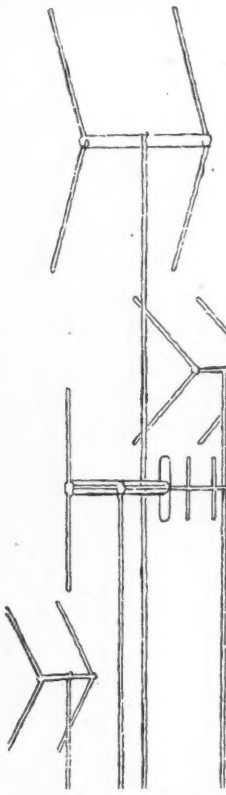

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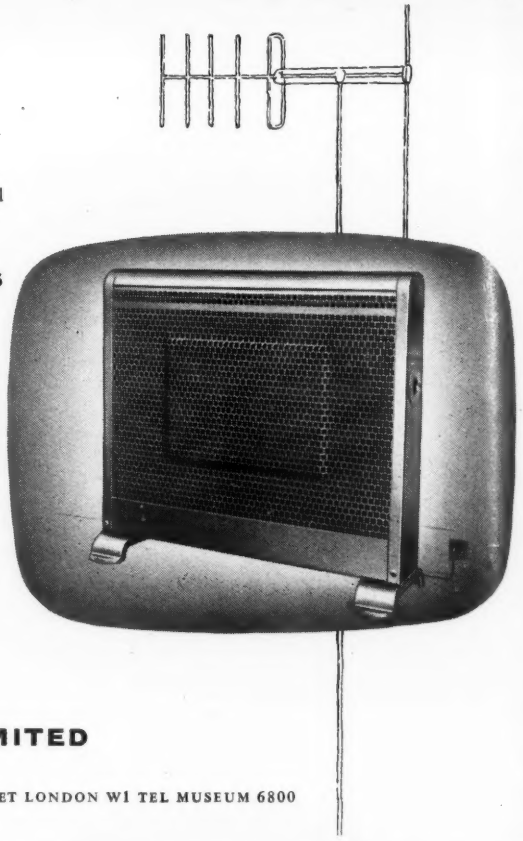

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ELECTRICAL REVIEW

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Nuclear Power Prospects

ALTHOUGH the International Conference on the Peaceful Uses of Atomic Energy at Geneva, which ends to-morrow, has considered a wide range of applications of nuclear energy and its derivatives, the development of industrial power has assumed the greatest importance. The known fuel resources of the world are rapidly dwindling in the face of ever-increasing calls for power and nuclear energy seems at the moment the only means of maintaining a balance.

So far power has been merely a by-product of experimental reactors. The 5,000 kW Russian station may possibly be an exception, but even if it has been kept in more or less continuous operation for over a year it is still experimental. The 50 MW Calder Hall twin reactor plant, expected to be started up next year, will be a more positive step; in design and construction it will be the model for the next four stations, with modifications suggested by operating experience with the two graphite-moderated pressurized-gas-cooled piles. Later stations may embody high-rated reactors which will use plutonium produced in the earlier types.

The Dounreay project is termed an " experimental " (as distinct from " research ") reactor. The aim is to demonstrate the feasibility of generating industrial power with fast reactors and the plant will feed a " useful quantity " of power into the grid. Apart from this several reactors for various research purposes are to be built.

In the United States work is proceeding on between forty and fifty types of reactors; a particularly interesting design is the boiling-water (direct steam raising) reactor described in one of the Conference papers and mentioned in our report in this issue. The Russians are talking of having a 100 MW station ready in a year's time.

As yet the cost of nuclear power is not easily assessable although there have been some good attempts at assessment. Too many assumptions have to be made but Mr. J. A. Jukes (United Kingdom) and Mr. J. A. Lane (U.S.A.), who presented separate papers on the subject, are agreed upon an upper limit of 7 mills (or 0·59d) per kWh as the cost of power from the earliest commercial atomic stations. This closely approximates the figure of 0·60d for power from a new coal-fired station.

Already there is talk of using heat from nuclear fission (popularly known as " H-power " because hydrogen is the agent). The President of the Conference (Dr. H. J. Bhabha) predicted the liberation of this form of energy in a controlled manner " within the next two decades," but leaders of the British delegation, while agreeing at a Press conference that controlled release of " H-power " would be achieved, were more cautious about the date.

The interchange of ideas on these and many other related subjects for the first time has made the Conference a historic occasion. Whether or not all secrets have been revealed is immaterial. As Sir John Cockcroft said at the Press conference, the lid had been taken off—not entirely off—and all had gained much more knowledge of things that were known about already. It may also be said that the Conference has done more to bring about co-operation for the benefit of mankind than any international political gathering could ever do.

REACTOR SAFETY

The serious consequences attending the failure of the supply of "light" or ordinary water to a reactor using this method of cooling, which were described at the Geneva atom conference, have long been recognized. The "runaway," deliberately caused by U.S. research scientists, was merely a practical demonstration of the justification for the adoption of gas cooling for present British designs which was given by Sir Christopher Hinton in his James Clayton lecture eighteen months ago (*Electrical Review*, 5th March, 1954). Water, in contrast to gas, absorbs more neutrons than does a graphite moderator. Deficiency of the coolant circuit, therefore, very greatly increases the number of neutrons available to promote fissions in excess of those required for maintaining a chain reaction. Gas-cooled reactors are inherently safe, since any tendency to supercriticality comes well within the range of control provided by the automatic insertion of neutron-absorbing boron rods.

GRADUATES IN INDUSTRY

Correspondence has recently been published in the *Manchester Guardian* on the dearth of science teachers in schools due to the much greater financial rewards offered by industry. Much the same topic appears from time to time in the columns of other daily papers. One correspondent, referring to the maximum salary achievable by him as a science teacher (with the responsibility allowance recently introduced) of about £1,130, thought that many of his sixth form pupils going into industry would be earning more than this before they were thirty. It is a common misconception applying to engineers as well as scientists; for although salaries in excess of this figure are undoubtedly more available to a young engineer than to a teacher the proportion paid as highly as this at 30 is quite small. The rank and file of the profession never reach a salary of this order. The pay of graduates in industry is rarely quoted by any company and by those outside is usually assumed as being much higher than is actually the case. We would not claim that our teaching profession is as well paid as it deserves but in industry as in teaching many a graduate stays in an interesting and worthwhile job despite his pay.

POWER STATION SITING

The new 300 MW generating station known as Stella South, which is described in this issue, is a remarkably good example of everything a modern generating station should be. It is ideally sited in that it is well placed with respect to local coalfields and has good rail access for fuel supplies. Another point is that it is more than usually well provided for in regard to cooling water supplies; in fact, the cooling capacity of the Tyne at this point is such that it has not been necessary to provide the station with cooling towers, the consequent economic advantages being obvious. However, Stella North, on the opposite bank of the river, is not so fortunate and the construction of four cooling towers has proved to be necessary. When Stella North is also in operation it will be interesting to compare the performances of two stations of similar design placed relatively close together, one operating entirely on river water cooling and the other using cooling towers.

ATOMIC "FUEL" SUPPLIES

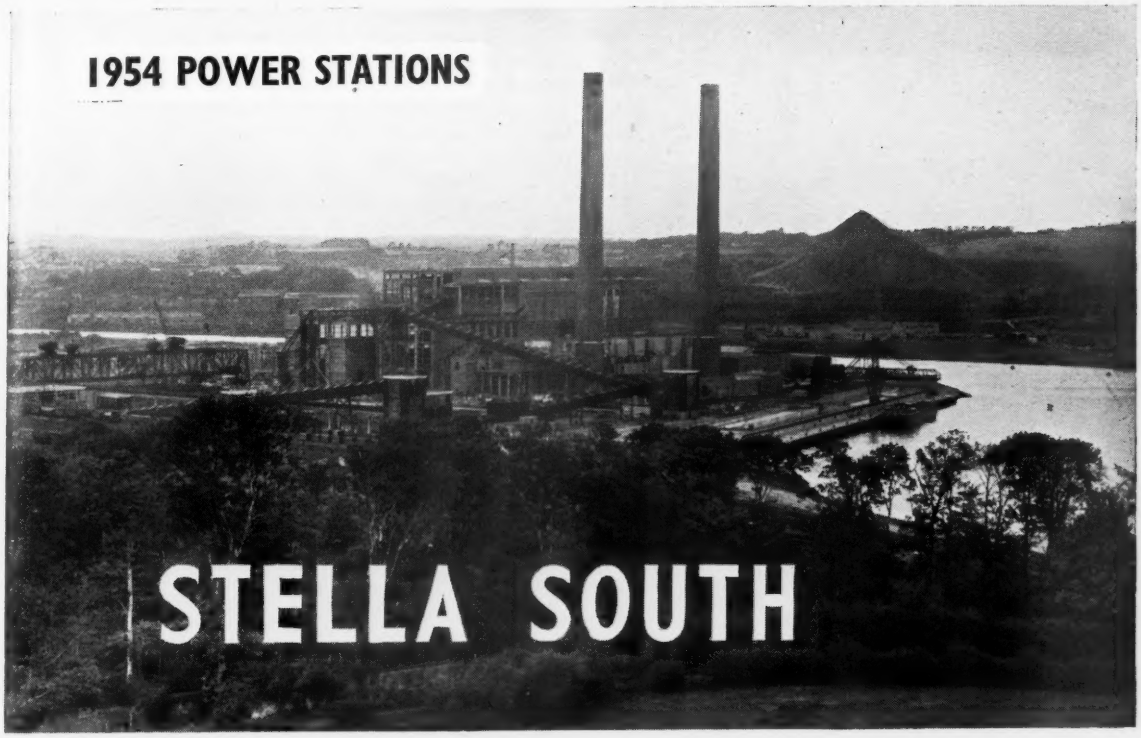
Fears have been expressed that with the extensive use of uranium for power reactors supplies of that mineral would become inadequate but it was announced at Geneva that an intensive survey has proved these fears to be unfounded; supplies of both uranium and the more commonly found thorium are thought to be ample. The position will be improved also by the more efficient use of nuclear "fuel." In avowing his optimism regarding supplies, Sir John Cockcroft said that the commercial supply of reactors by this country would depend upon the results obtained from the operation of Calder Hall. By the early 'sixties it would be seen how the supplies of uranium were developing.

SOCIETY PROCEEDINGS

During the holiday season when in the main there is a lull in the proceedings of the learned societies, conferences, etc., it is a good thing to think back or take stock. As has been the case for some years we are at the moment left with the impression that some of the papers which we have heard "presented" in summary form are not sufficiently closely related in that form to the original papers. This impression has been brought about by working on the papers proper in advance and afterwards hearing them delivered in summary form. In these days of rapid growth of technologies we do appreciate the necessity to cut down the delivery time by "presenting" papers in abstract form, but we think that the greatest care should be taken to make the summaries reflect the originals because some of those who attend the meetings to hear the papers also find it necessary to save time by relying on the summaries only. Then there is the question of discussions on the papers and a properly related summary evokes a higher quality of discussion—a fact which is more evident in the cases of papers on higher technologies. Incidentally the term "presented" seems to have taken on different meanings in some quarters nowadays. Once the terms "read," "delivered" and "presented" were regarded as synonymous, but now there is evidence of "read" taking its literal meaning and "presented" signifying read in summary form.

PLASTICS IN INDUSTRY

It is an unfortunate fact that plastic materials generally have in so many instances been used for applications by no means suited to their characteristics. This has no doubt given rise to the impression that plastics are cheap and possibly inferior substitute materials. This is entirely wrong and when one looks at the applications of plastics in the electrical industry one can see that there are many instances where the use of plastics is imperative if maximum efficiency of operation is to be achieved. Plastic insulated cables are typical and the manufacturing techniques and range of products of British Insulated Callender's Cables, Ltd., described in this issue, demonstrate many of the advantages to be obtained.



First 60 MW Unit Commissioned in Stella South

IT is now over six months since the commissioning of the first 60 MW unit of the five similar sets which are in course of construction in Stella South generating station near Newcastle-upon-Tyne. This station, which is on the south bank of the River Tyne and on the actual site of the old Blaydon race track referred to in the well-known Tyneside song, will operate initially as a base load generating unit, but ultimately it is intended that it shall assume peak load duties. On the north bank of the river, exactly opposite Stella South, will be Stella North, the first set in which was commissioned in June this year. The two stations, although separately administered, will be very much alike, the boiler and turbo-alternator units being of identical design and manufacture. However, Stella South will have five 60 MW sets and operate exclusively on river water cooling, while Stella North will have four 60 MW sets and operate on cooling towers.

The Stella South site lies between the river and the railway by means of which all coal is conveyed to the station. The river is navigable for shallow draught vessels and all ash, after treatment, is taken out to sea by barge and dumped. The main building, which is a brick structure with two 375ft high brick chimneys laid out in the manner indicated in the site plan, is of clean appearance and follows standard practice for unit-type stations. The hydrogen-cooled turbo-alternators are arranged side-by-side down the turbine room with the turbine ends adjacent to their respective unit boilers, there being no dividing wall between the turbine room and boiler house. In a separate building, to the west side of the main building, are the offices and control room, there also being a maintenance building, welfare block, canteen, stores and cooling water pumphouse on the north part of the site. The ash settling ponds are adjacent to a jetty for the barges, while the coal store runs parallel to the railway sidings and at right angles to the main station building.

As already mentioned, there are five boilers in the station. Supplied by Clarke, Chapman & Co., Ltd., they are of the radiant type fired with pulverized fuel and have a maximum continuous rating of 550,000 lb/hr of steam, the pressure and temperature of the steam at the superheater outlet being 950 lb/sq in and 925 deg F. The combustion chamber is completely water cooled by 3¼in o.d. tubes pitched at $3\frac{5}{16}$in, the corner tubes being of finned construction. Pulverized fuel burners of the tilting type are accommodated in each corner of the chamber. A water-walled pass at the rear of the combustion chamber envelopes the primary superheater and the economizer. The tubes in this section form the downcomers supplying the furnace walls.

The horizontal type primary superheater is supported by sling rods from the building steelwork, while the economizer, situated directly below the primary superheater, is supported from the downcomer tubes. A damper controlled water-cooled chamber provides a path for gases to by-pass the primary section of the superheater and it serves as a subsidiary means of superheater steam temperature control. The boiler and superheater are suspended from the building structure and all expansion takes place vertically downwards. Each unit is equipped with two Howden-Ljungstrom rotary regenerative air preheaters and Sturtevant electrostatic precipitators.

Each boiler has one direct mounted water gauge and one extended water gauge, while there is also a high and low water alarm of the external type made by Hopkinsons, Ltd. The feed water is regulated by a Cope's "Flow-matic" system, which is responsive to both boiler water

No. 3 boiler under construction

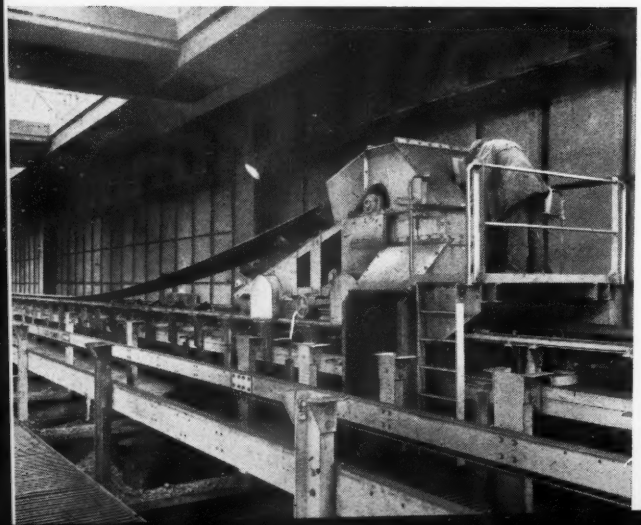
level and steam flow. Steam temperature is controlled by corner firing tilting burners, which are positioned by Kent automatic air-operated equipment and will maintain control of steam temperature between 70 per cent and 100 per cent of designed maximum steam output. The superheater gas by-pass damper is intended for use as a "setting" control, to cater for changes in cleanliness of the heating surfaces, abnormal operating conditions, etc. Each boiler is also fitted with 22 electrically operated Clyde soot blowers to give sequence and/or selective operation. The steam supply for the soot blowers is taken from the intermediate header between the primary and secondary superheaters.

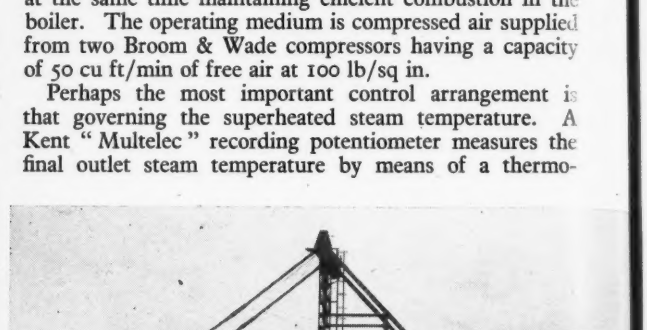
For each boiler there are four Clarke, Chapman "Raymond" bowl mills size 613. A roll type feeder delivers 11·6 tons/hr of raw coal to each mill, each feeder receiving its coal via a Simon weigher from the overhead bunkers. One Keith Blackman exhauster fan serves each mill unit and this is driven through a flexible coupling by a 176 h.p. variable speed motor. Speed variations of 1,470 to 970 r.p.m. are obtained by a servo motor controlled induction regulator. Each boiler is equipped with two f.d. and two i.d. fans of Howden manufacture, the former being driven by 224 h.p. 730 r.p.m. motors and the latter by 479 h.p. 730 r.p.m. motors.

The boiler units are equipped with a complete Bailey automatic control system the object of which is to ensure that sufficient steam is available at the turbine stop valve for the load on the turbo-alternator at any instant, while at the same time maintaining efficient combustion in the boiler. The operating medium is compressed air supplied from two Broom & Wade compressors having a capacity of 50 cu ft/min of free air at 100 lb/sq in.

Perhaps the most important control arrangement is that governing the superheated steam temperature. A Kent "Multelec" recording potentiometer measures the final outlet steam temperature by means of a thermo-couple in the steam main. This instrument is fitted with an air-operated controller which is adjustable over a wide range. The controller produces an air pressure which is a function of the final steam temperature, and any variation in this temperature results in an air impulse being transmitted to the positioning mechanism of the power cylinders actuating the adjustable tilting burners in response to the controller signals. In this manner a constant steam outlet temperature is maintained. A selector valve and pressure regulator provides for remote manual operation of the temperature regulating mechanism if required. Local manual operation is also provided for use in the event of failure of air supply.

Bunker filling conveyor with travelling side discharge carriage above the boiler bunkers





Ash is transferred from the settling ponds and loaded into barges for disposal at sea

All coal is delivered to the station by rail, and sidings are provided for the temporary storage of two days' supply of coal trucks and the same number of empty trucks. There are three filler pits, two of which receive coal from bottom emptying trucks while the third is supplied from a side tippler. Each pit is capable of discharging coal by means of electromagnetic vibratory feeders at a rate of 300 tons/hr. The coal is conveyed by belting from the filler pits to the bunkers and/or the storage ground and from the storage ground to the bunkers. All belts are of 300 tons/hr capacity and travel at 350 ft/min.

The coal store, which is served by a travelling gantry provided with two fixed radius grabbing cranes for coal reclaiming, has an approximate storage capacity of 80,000 tons (unconsolidated) when stacked to a depth of 14ft. The capacity of each boiler bunker is 55,000 cu ft, which is equivalent to a coal storage of about 1,250 tons.

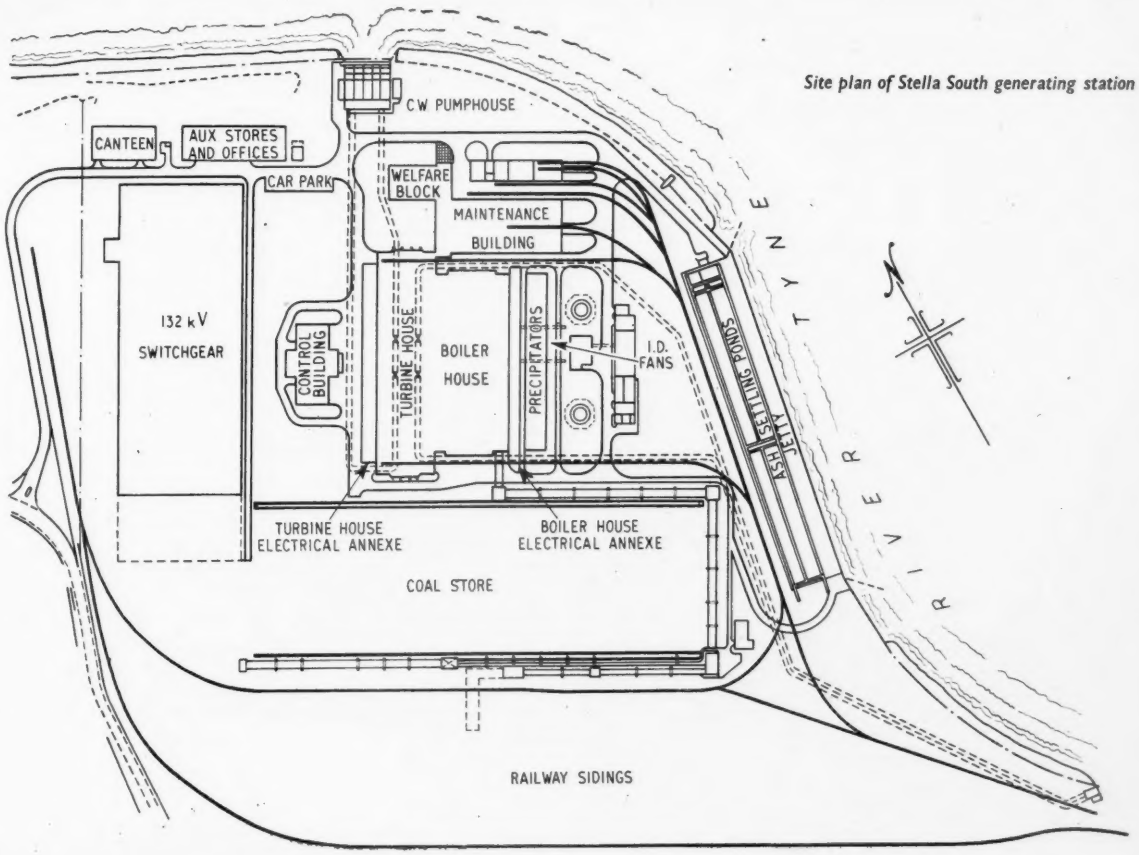
The ash and dust handling plant is of Babcock & Wilcox manufacture. The ash is collected in hoppers beneath the furnace of each boiler and is removed into a sluiceway by high pressure oscillating water jets. At intervals along the sluiceway are water jets which direct the ash to one of the duplicate clinker grinders through which it passes before entering an ash sump. A valve in the sluiceway allows the water and ash mixture to be admitted to the selected clinker grinder. The water and ash mixture is then pumped by one of the three, 2,200 gal/min centrifugal type ash pumps to the ash and dust settling ponds.

There are four reinforced concrete settling ponds each 285ft long by 30ft wide and 14ft deep. Water from these ponds passes through coke filters and drain louvres into a return water gulley leading to the drain sump. One of three centrifugal type 2,200 gal/min transfer pumps delivers water from the drain sump to the recirculating water reservoir. Alternatively, the water can be discharged to the river, in which case the h.p. recirculating pumps draw water from the cooling water culvert. The transfer pumps are in a building adjoining the settling ponds together with two sealing water pumps and a lancing pump. The water to the latter pumps is supplied from the river water tanks. The h.p. recirculating pump house and the 400,000 gal capacity reservoir are situated between the ash pump house and the transfer pump house. The three h.p. recirculating water pumps are two-stage centrifugal units each designed to deliver 1,800 gal/min against a 275ft head. The selected pump supplies the h.p. water to the oscillating and ash sluiceway nozzles and also to the ejector nozzles of the dust extracting plant.

When the plant is in operation the ash sump level gradually falls due to the difference in capacity between the ash and h.p. circulating water pumps. At a predetermined level a thrustor valve operates and admits water from the reservoir to the ash sump. When normal high level is reached the thrustor valve shuts. Two 500 gal/min overflow pumps controlled by "No Flote" switches are provided in the ash pump house to drain the overflow pit adjoining the ash sump.

Dust is extracted from the precipitator hoppers by water operated feeder ejector units and from the chimney bases by hydro-vactors. The h.p. water is taken from the recirculating pump discharge main and the resultant dust and water mixture discharged into the sluiceway. As already indicated the wet ash and dust is removed by crane from the settling ponds and loaded into barges for disposal at sea.

Each boiler is fed by four 11·6 tons/hr "Raymond" bowl mills



Site plan of Stella South generating station

The five Parsons turbines are designed to operate with steam conditions before the turbine stop valve of 900 lb/sq in and 900 deg F and to have an output of 60 MW at maximum and economical continuous rating. They are of the three-cylinder reaction type and run at a normal speed of 3,000 r.p.m. Steam is bled for five stages of feed heating giving a designed final feed temperature of 385 deg F. At a load of 60 MW with a final feed temperature of 385 deg F and an absolute back pressure of 1·1in Hg the specified steam and heat consumptions are 8·394 lb/kWh and 9,217 B.Th.U./kWh respectively.

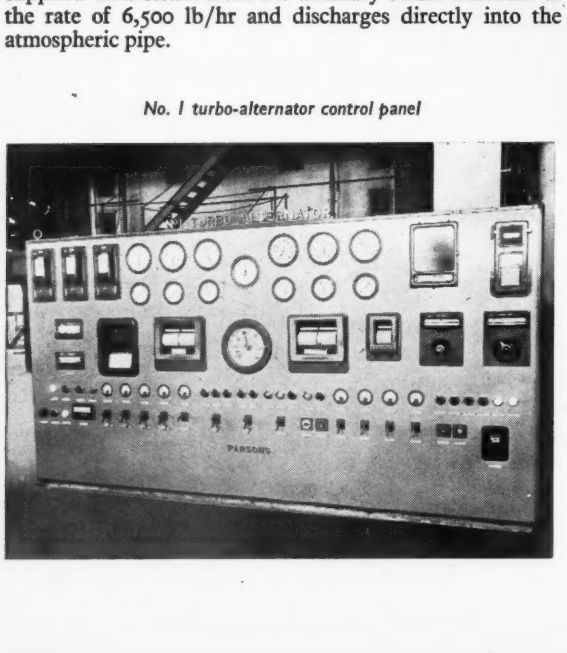
The cylinders are arranged in line. The h.p. cylinder is anchored at the exhaust end and the l.p. cylinder at the forward end adjoining the exhaust end of the i.p. cylinder to which it is solidly connected. The latter therefore expands towards the h.p. turbine. The h.p. and i.p. rotors are connected by a double-claw flexible coupling and the i.p., l.p. and alternator rotors are solidly coupled. Residual thrusts in the h.p. rotor and in the i.p., l.p. and alternator rotor assembly are catered for by Michell thrust blocks, the thrust block fitted to the h.p. turbine being adjustable so that close axial clearances can be maintained under running conditions.

The main gear type oil pumps supply two separate systems, "lubricating" and "power" oil when the turbine is running at speed. A motor driven auxiliary oil pump is used during running-up, emergencies and shutting down periods and operates in parallel with the main oil pump. The auxiliary oil pump is started automatically in the event of failure of the main oil pump. In addition, a d.c. motor-driven emergency oil pump starts up automatically should both the main and auxiliary pumps fail. This supplies oil to the bearings only. A motor driven l.p. oil pump supplies oil to the bearings when the turbine shaft is being barred over by the 10 b.h.p. barring gear motor.

Under normal load conditions steam to glands is obtained from the exhaust of the h.p. turbine. During running-up and under light loading conditions steam to glands is supplied from the auxiliary steam manifold through a pressure regulator or a separate by-pass line.

There are two Parsons three-stage air ejectors and one quick-start air ejector for each turbine. The three-stage units are condensate cooled and each operates at a steam pressure of 600 lb/sq in, while the quick-start ejector is supplied with steam from the auxiliary steam manifold at the rate of 6,500 lb/hr and discharges directly into the atmospheric pipe.

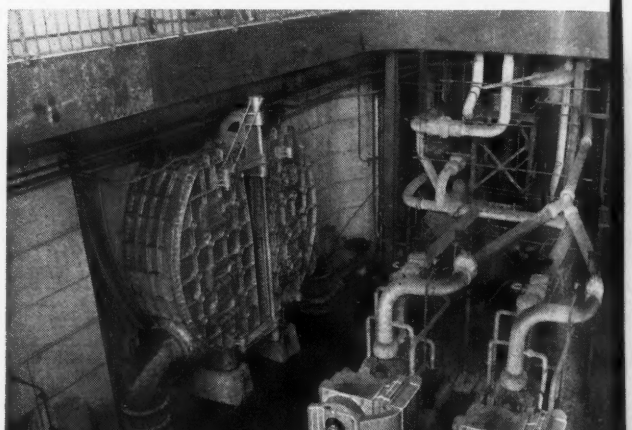
No. 1 turbo-alternator control panel



Two 100 per cent duty 750 gal/min two-stage vertical extraction pumps are driven by L.D.C. motors at 975 r.p.m. When working in parallel each pump delivers 485 gal/min of condensate against a head of about 220ft. The output from these pumps is governed by the water level in the condenser by the operation of a float controlled valve in the common discharge line from the pumps.

The feed heating train consists of four surface heaters, one contact or de-aerator heater and a drain cooler. All heaters are of Parsons manufacture except the de-aerator heater which was made by Worthington-Simpson. Condensate is pumped from the condenser at 81·8 deg F by either or both extraction pumps and is fed via the condensate float operated control valve, through the main and/or standby air ejectors, drain cooler, l.p. heaters, vent condenser and preheater and then through nozzles of the de-aerator heater before entering the de-aerator storage tank. The two 100 per cent duty feed pumps for each boiler draw water from the de-aerator storage tank and discharge through numbers 4 and 5 h.p. heaters, and via the main feed valve and Cope's regulating valve to the boiler. The feed pumps are six-stage centrifugal units made by Sulzer Brothers and each is driven by a 1,425 h.p. 3·3 kV English Electric squirrel cage induction motor.

The boiler feed consists of turbine condensate and about 1½ per cent of treated town water. This make-up water which is obtained from a five stage Permutit



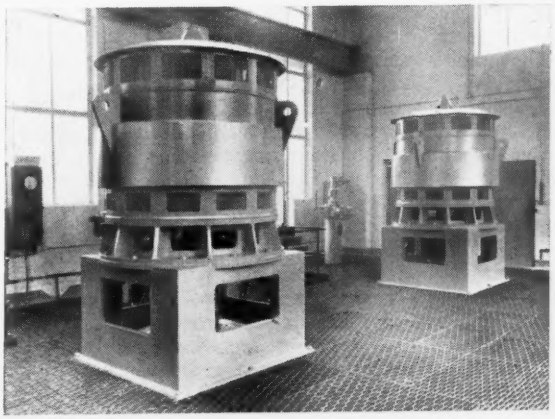
Two six-stage centrifugal type electrically driven feed pumps are provided for each generating unit

"Deminrolit" plant has a high degree of purity and contains only a trace of silica and carbon dioxide. The plant is designed for two half duty sections each capable of producing a final maximum throughput of 6,450 gal/hr giving a total of 12,900 gal/hr when the two sections are operated in parallel.

The Parsons condensers are of the surface type and have three passes, the total cooling surface being 57,000 sq ft and the normal cooling water requirement 38,000 gal/min. The condenser is so arranged that half of its cooling water side can be isolated for cleaning purposes while the turbine is operating at reduced load. The tubes are expanded into the tube plate at the inlet ends and have packed glands at the outlet ends. A novel feature is

that a row of solid iron bars is fitted above the condenser tubes to prevent damage to the tubes in the event of l.p. turbine blades being shed. An atmospheric relief valve is connected to one of the exhaust trunks of the l.p. turbine, and is sealed by water supplied from the extraction pump discharge via a tank fitted with a float controlled valve. Each condenser is fitted with a water lever gauge and a float operated switch to give audible warning of high water.

The chlorinating plant, supplied by Wallace & Tiernan, Ltd., is designed for chlorinating the condensers and auxiliary cooling plant of each of the five turbo-alternators in rotation, the water quantity required for each unit being 40,200 gal/min. The capacity of the master

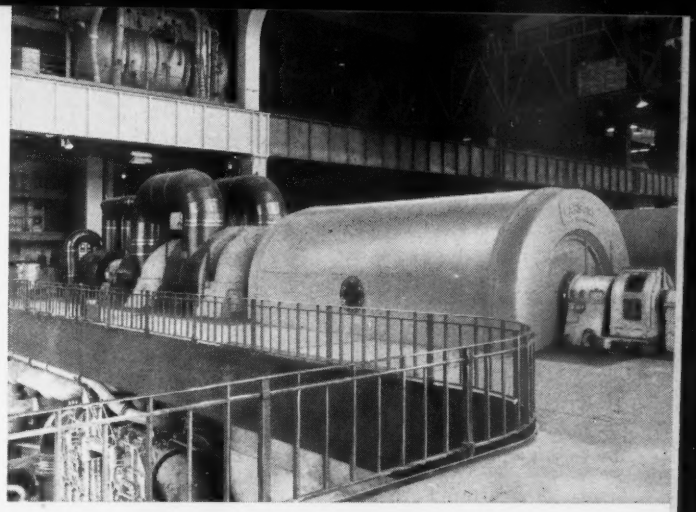


Two of the five main c.w. pumps in the river water pump house

chlorinator is 4,000 lb of chlorine per 24 hr and the control is by means of an automatic intermittent programme clock. The 120 gal/min 135 lb/sq in 27·5 h.p. injector pump is of the centrifugal type, the control equipment and the pump being in the electrical annexe on the west side of the main station building. River water is used for injection and town main water for control and auxiliary purposes.

The circulating water pump house contains five Gwynne's vertical centrifugal type circulating water pumps with their associated screening plant. Each is driven by an English Electric 7,301 h.p. 367 r.p.m. 3·3 kV squirrel cage motor arranged for direct-on-line starting and delivers 42,000 gal/min against a 45ft head.

The 60 MW, 11·8 kV, hydrogen cooled alternators and the gear driven air cooled exciters are of Parsons manufacture. Circulation of both hydrogen and air is by means of fans mounted integral with the rotor and exciter shafts. Heat is transferred from the hydrogen to the river water in two stages. In the primary cooling stage one of two vertical centrifugal motor driven pumps, running at 1,460 r.p.m. and capable of delivering 700 gal/min against a discharge pressure of 17·5 lb/sq in, pumps distilled water through a closed loop formed by the gas coolers and two surface type heat exchangers. In the secondary stage river water passes from the cooling water inlet culvert through strainers and heat exchangers to the cooling water outlet culvert. The distilled water extracts heat from the hydrogen in the gas coolers and transfers it to the river water in the heat exchangers. To prevent excessive leakage of hydrogen between the rotor shaft and stator frame, oil seals are fitted at each end of the stator casing. The oil supply to these seals is normally taken from the main turbine oil system. The a.c. motor driven



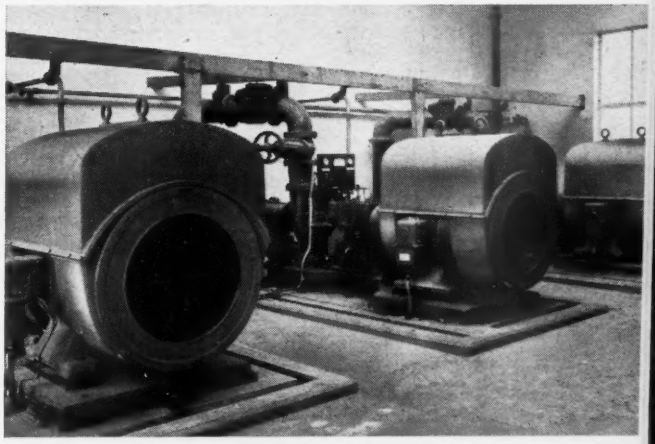
No. 1 turbo-alternator showing unit boiler and feed heater de-aerator in the background

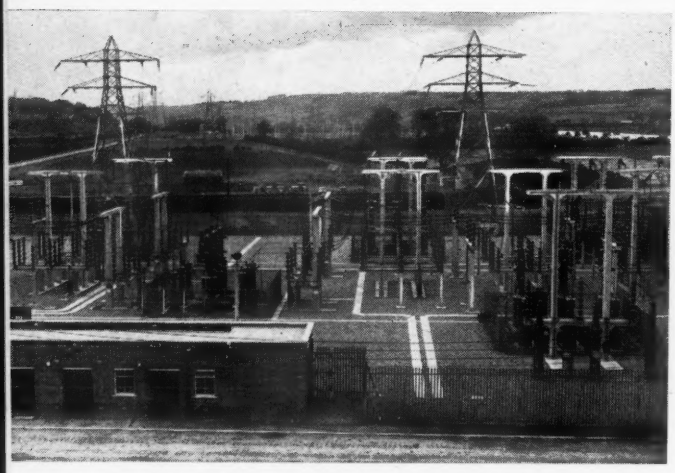
gear type standby seal oil pump runs at 1,700 r.p.m. and delivers oil at 60 gal/min against a discharge pressure of 50/60 lb/sq in. There is also a smaller d.c. motor driven seal oil pump for use in emergencies.

The exciter is gear driven at 1,000 r.p.m. and comprises an exciter and pilot exciter on the main shaft. Excitation control is by a motor driven rheostat in the field of the main exciter. A Metrovick automatic voltage regulator is fitted to each alternator. A feature of the exciter is the negative winding which provides a small constant magnetic field in parallel with and opposing the main exciter field. This negative winding permits the use of a smaller rheostat than would otherwise be necessary for the wide range of excitation required. In addition, a motor operated rheostat is provided in the control circuit of the regulator with sufficient range to enable the regulator to operate between + 5 per cent and − 20 per cent of rated alternator voltage.

Each alternator is solidly connected to both a 6 MVA, 11·8/3·45 kV unit transformer and a 72 MVA, 11·8/141·6 kV generator transformer. The latter transformers, which are housed in outdoor cells on the west side of the main station building, are connected to the 132 kV switching station in a compound on the opposite side of the office block. The switchgear is Reyrolle air-blast type 1320B14, rated at 800 A normal current and 3,500 MVA breaking capacity at 132 kV and is designed for outdoor operation. Each unit can be connected to either of two busbars, "main" or "reserve," and con-

H.p. sluicing pumps used in conjunction with the ash plant





132 kV substation with 275 kV substation in background and compressor house in foreground

sists of busbar selectors, circuit-breaker and isomaker. The circuit-breakers are three single-phase units mechanically and pneumatically connected, each having four air blast turbulators in series with a sequentially operated isomaker. Each phase is operated by air from its own local air receiver.

Tappings taken from the outgoing overhead lines are connected to post mounted rotary type line isolators, each phase consisting of three post insulators, the centre one carrying a movable conductor. Three movable conductors are ganged and mechanically connected to the local hand-operating lever. Three-phase line earthing switches are provided and are opened and closed by means of a mechanically connected hand operating lever. From the circuit-breaker side of the line isolators rigid connections are made to post type current transformers, and from the current transformers to the circuit-breaker. Rigid connections are also made between the isomakers, on the busbar side of the circuit-breaker, and the top of post mounted insulators. Cable connections are taken from these terminals to a three-phase local overhead line extending from the concrete posts carrying the initial connections from the overhead line terminal tower to concrete posts midway between the "main" and "reserve" busbars.

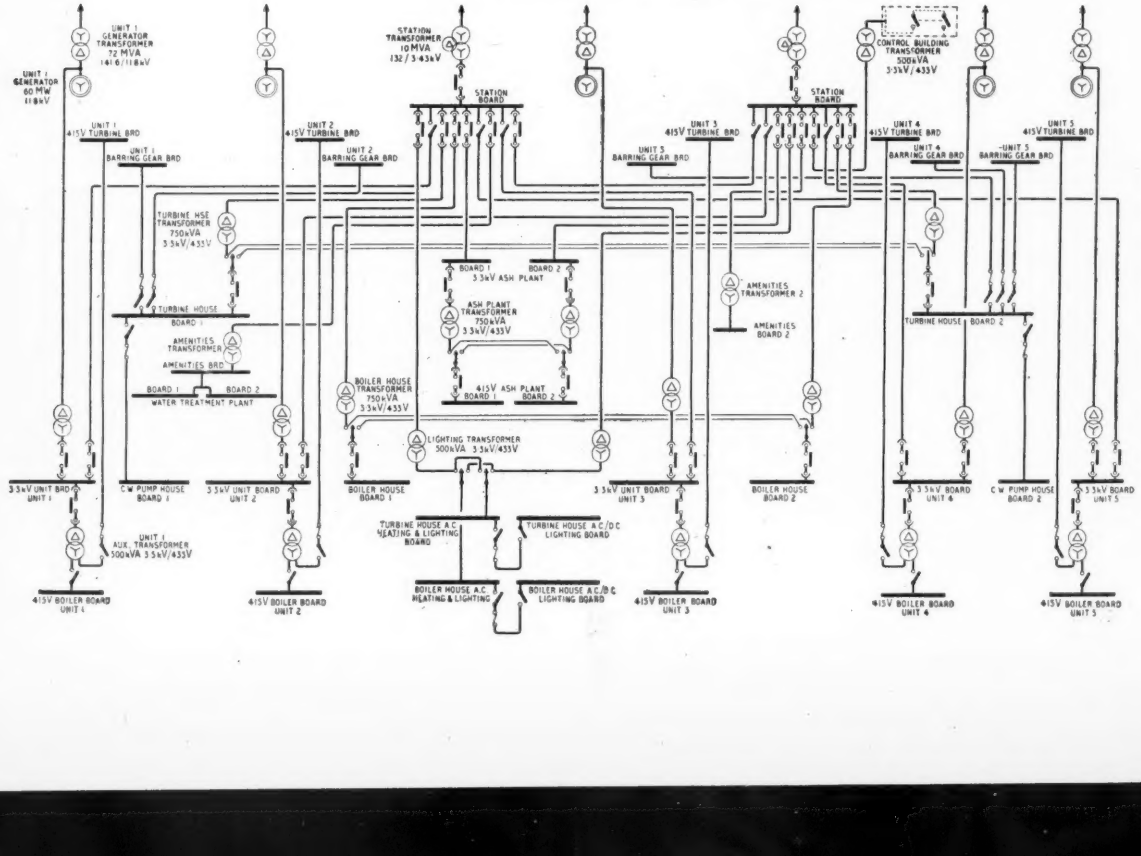
The main busbars, which run the length of the switchgear compound, can be split into two systems by a bus section switch in the centre of the main busbar. Similarly the reserve busbars can be sectionalized by means of rotary type bus section isolators in the middle of the reserve busbars. Two bus coupler switches are situated at the ends of the busbars.

The system of connection for generators and station transformers is essentially as described for circuits supplying the overhead lines except that there are no line isolators. The incoming underground cables are taken to sealing bells mounted on steel supporting structures and from there rigid connections are made to the earthing switches mounted on the concrete posts which carry the local overhead lines.

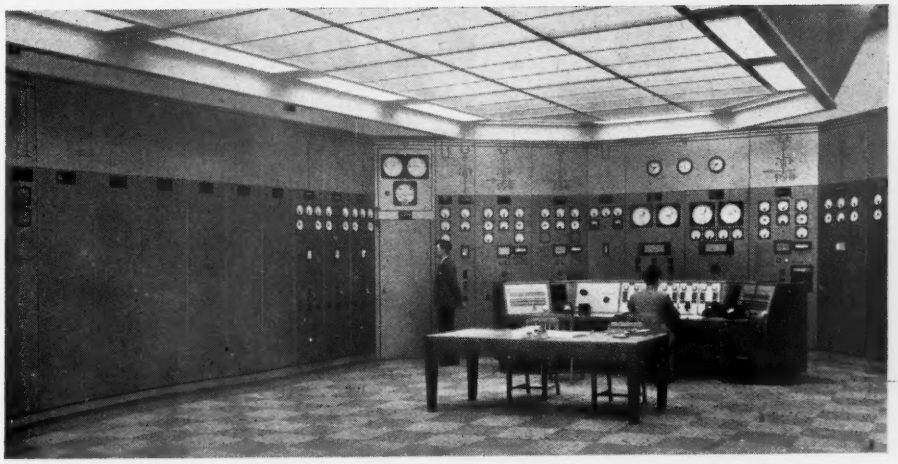
A diagram of the system of interconnection between the station, unit and auxiliary boards is reproduced below. A unit transformer is solidly connected to the output terminals of each turbo-alternator and under normal running conditions supplies an associated 3·3 kV unit board. The unit boards can be supplied alternatively from station boards 1 and 2. The respective station boards are fed at 3·3 kV by station transformers 1 and 2 which take their supply from the 132 kV busbars. These boards may be connected through a 3·3 kV circuit-breaker and operated on a common or sectionalized system depending on plant conditions. The unit and station transformer circuit-breakers may be operated remotely at the control room or locally at the circuit-breaker panels. Each unit board supplies through transformers a unit boiler and a unit turbine board at 415 V.

The two station boards each supply, through trans-

System of interconnection between the station, unit and auxiliary boards


UNIT 1 GENERATOR TRANSFORMER 72 MVA 141·6/118kV
UNIT 1 GENERATOR 60 MW 11·8kV
STATION TRANSFORMER 10 MVA 132/3·43kV
STATION BOARD
CONTROL BUILDING TRANSFORMER 500kVA 3·3kV/433V
UNIT 1 415V TURBINE BRD
UNIT 1 BARRING GEAR BRD
UNIT 2 415V TURBINE BRD
UNIT 2 BARRING GEAR BRD
UNIT 3 415V TURBINE BRD
UNIT 3 BARRING GEAR BRD
UNIT 4 415V TURBINE BRD
UNIT 4 BARRING GEAR BRD
UNIT 5 415V TURBINE BRD
UNIT 5 BARRING GEAR BRD
TURBINE HSE TRANSFORMER 750kVA 3·3kV/433V
TURBINE HOUSE BOARD 1
AMENITIES TRANSFORMER
AMENITIES BRD
BOARD 1
BOARD 2
WATER TREATMENT PLANT
BOARD 1 3·3kV ASH PLANT
BOARD 2
ASH PLANT TRANSFORMER 750kVA 3·3kV/433V
415V ASH PLANT BOARD 1
BOARD 2
AMENITIES TRANSFORMER 2
AMENITIES BOARD 2
TURBINE HOUSE BOARD 2
BOILER HOUSE TRANSFORMER 750kVA 3·3kV/433V
LIGHTING TRANSFORMER 500kVA 3·3kV/433V
3·3kV UNIT BRD UNIT 1
C.W. PUMP HOUSE BOARD 1
3·3kV UNIT BOARD UNIT 2
BOILER HOUSE BOARD 1
3·3kV UNIT BOARD UNIT 3
BOILER HOUSE BOARD 2
3·3kV BOARD UNIT 4
C.W. PUMP HOUSE BOARD 2
3·3kV BOARD UNIT 5
UNIT 1 AUX. TRANSFORMER 500kVA 3·3kV/433V
TURBINE HOUSE A.C. HEATING & LIGHTING BOARD
TURBINE HOUSE A.C./D.C. LIGHTING BOARD
BOILER HOUSE A.C. HEATING & LIGHTING
BOILER HOUSE A.C./D.C. LIGHTING BOARD
415V BOILER BOARD UNIT 1
415V BOILER BOARD UNIT 2
415V BOILER BOARD UNIT 3
415V BOILER BOARD UNIT 4
415V BOILER BOARD UNIT 5

Mr. W. F. Cusworth, superintendent of Stella South



General view of the control room

formers, Nos. 1 and 2 turbine house, boiler house, ash plant and amenities boards at 415 V. Nos. 1 and 2 boards are normally supplied from their respective transformers but it is possible to feed them instead from Nos. 2 and 1 transformers respectively. A turbine house lighting board and boiler house lighting board may be supplied at 415 V from either No. 1 or No. 2 lighting transformer. The lighting transformers are fed from their respective station boards.

The 3·3 kV air-break switchgear is of the Reyrolle 527A and 530A horizontal draw-out metalclad type. The normal current rating is 800 A for the former and 1,600 A for the latter, the breaking capacity in each case being 150 MVA. The 415 V air-break switchgear of Reyrolle 522A and 532A types has current ratings of 1,200, 1,600 and 2,400 A with a breaking capacity of 25 MVA.

The consulting engineers for the station are Merz & McLellan, while the main contractors are:—Civil engineering works, Sir Robert MacAlpine & Co., Ltd.; boilers, Clarke, Chapman & Co., Ltd.; turbo-alternators, C. A. Parsons & Co., Ltd.; switchgear, A. Reyrolle & Co., Ltd.; ash handling plant, Babcock & Wilcox, Ltd.; coal handling plant, Dempster & Co., Ltd.; feedwater treatment plant, Permutit Co., Ltd.; de-aerator and general pumps, Worthington-Simpson; cables, Pirelli-General Cable Works, Ltd.

Acknowledgment is due to Mr. J. C. Mitchell, Divisional Controller, North Eastern Division, Central Electricity Authority, for permission to publish this article, and to Mr. W. F. Cusworth, superintendent of the Stella South station, for the assistance which he gave us in its preparation.

South African Electrical News

THE financing of Cape Town's new power station, to be built at Athlone, will involve the biggest loan ever to be raised for one project in the city's history. The total cost is estimated at £14 million. It will take about ten years to finish the station, which will be brought into commission in three or more stages. Recently the City Council asked to receive the authority of the ratepayers and the approval of the Cape Administrator to raise a loan of £7,000,000 for the first stage of the undertaking, which is estimated to cost £6,769,000. It will include two 30,000 kW turbo-alternators, three boilers, buildings and certain equipment for later stages. The first turbo-alternator is required to be in service by the winter of 1960. When finished in about 1965, the station will have six turbo-alternators and eight boilers. The city treasurer said that after the authority had been obtained the money would be raised, not all in one loan but in varying amounts to meet estimated expenditure on the project from year to year. A similar procedure was now being followed to finance the £6,000,000 Wemmershoek Dam and pipeline project, which was the biggest loan item yet sponsored by Cape Town. The city electrical engineer had said that electricity would be produced by the new power station at a lower cost than it could be purchased in bulk from the Electricity Supply Commission.

In his presidential address to the 29th annual convention of the Association of Municipal Electricity Undertakings of Southern Africa, in Pretoria in May, the city electrical engineer of Pretoria predicted that £470 million would be needed by South African municipal electricity undertakings in the next twenty years to finance extensions to the growing power generation and distribution undertakings.

The rapid expansion of industry in South Africa is clearly indicated by the sharp rise in the South African Reserve Bank's index of electricity generated by the principal undertakings, which has increased by 68 per cent since 1948, the base year. In April, 1955, about 11 per cent more power was generated than a year before, and nearly 20 per cent more than in 1953. The Electricity Supply Commission's £185 million capital expenditure programme is not yet completed, but great strides have been made at Taaibos in the north of the Orange Free State, where one generator is operating, and at Vierfontein, which is half completed. Despite these additions, however, the demand for power is far from satisfied. The Commission's chief customer, the mining industry, is not yet receiving sufficient power to obviate the necessity of taking special measures to prevent inadequate power supplies from restricting output. The chairman of the Rand Mines group, however, said recently in his annual report that the general supply position was improving but that the improvement would inevitably be accompanied by higher prices.

An electric lamp factory established in Grahamstown three years ago has temporarily stopped production because of over-production caused by lack of support and competition from Japanese-made bulbs. The manager said that he was keeping on a skeleton staff to keep necessary work going. The factory could produce a million miniature bulbs a year, the amount imported annually.

D. C. Galvanometers

Two Instruments Incorporating A.C. Amplifiers

By E. H. W. BANNER, T.D., M.Sc., M.I.E.E., M.I.Mech.E.*

AMONG the various forms of d.c. amplifier-galvanometers two common types incorporate either photo-cells with subsequent amplification, or a d.c. moving coil directly associated with an a.c. moving-coil circuit followed by a.c. amplification. The first type is well known but the second is of later development; two examples of the latter type are briefly described here.

In each case a d.c. input signal (too small to provide a readable deflection other than by the use of a very sensitive laboratory reflecting instrument with a long scale and which would have a high resistance and low speed of response) deflects a moving coil by a very small angle and causes a small alternating potential to be developed by a coil in an a.c. field. This induced e.m.f., which is proportional in magnitude and in phase to the polarity of the

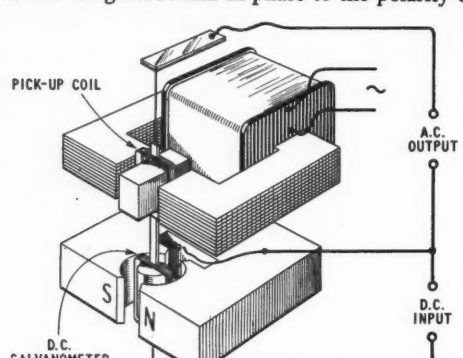


Fig. 1.—Moving-coil systems of the d.c. microvoltmeter

input signal, is then amplified by a suitable a.c. amplifier with negative feedback to provide stability, the amplified output again being proportional in magnitude and in polarity to the input signal to be measured, and which is able to operate a normal robust moving-coil milliammeter or to form part of an automatic potentiometer or error-resolver. Each of the two instruments described provides a calibrated scale reading which is much lower than is possible with normal robust indicating instruments.

In both the instruments there is a moving coil forming the primary or input for the d.c., but in the first the d.c. coil is rigidly coupled to an a.c. moving coil, the latter being in an alternating magnetic field. In the second instrument the moving coil carries the input d.c. and also the induced a.c. which is proportional to it. The first instrument may be briefly described as a normal moving-coil galvanometer movement coupled to an a.c. amplifier through a pick-up coil carried on the moving system. The amplified a.c. is converted to d.c. via a phase-sensitive valve rectifier, proportional in amount and in direction to the input signal. A feedback connection is made from the amplifier to the primary d.c. circuit which then provides stability against mains voltage fluctuations and in part forms a sensitivity control.

The basic element of the system is a moving coil held by a double-taut suspension, the second and coupled coil swinging in the air-gap of a laminated magnetic system having a.c. excitation (see Fig. 1). The application of a small input signal causes a very slight rotation of the d.c. coil which also rotates the a.c. coil by an equal amount, the a.c. coil thus having induced in it a small alternating voltage of a phase relationship depending on the direction of motion, and hence on the polarity of the input signal. This induced a.c. feeds the control grid of a pentode acting as an amplifier, and the output then passes to the two halves of a double-triode connected in opposition as a phase-sensitive rectifier. The phase-sensitive rectifier is simply the double-triode valve in which the two anodes are fed with a.c., each from a secondary winding on the main transformer, but the connections to one valve anode are reversed, thus providing 180 deg phase difference between the two anodes. The output is then dependent on the relative phase relation of the a.c. input which is proportional to the polarity of the input d.c. signal. This part of the circuit is shown in Fig. 2, separated from the main outline circuit of Fig. 3, to avoid unnecessary confusion.

A feedback connection is taken to the input circuit as shown in Fig. 3. The feedback point is adjustable for a sensitivity control, the sensitivity having four ranges which in this instrument are multiples of ten. On the two lower ranges the feedback resistance is altered and for the higher ranges adjustment to a potential divider is made. The two switches shown are coupled. After rectification by the phase-sensitive rectifier the amplified d.c. is passed

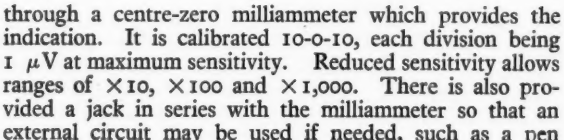


Fig. 2.—Basic circuit of phase sensitive rectifier

through a centre-zero milliammeter which provides the indication. It is calibrated 10-0-10, each division being 1 μV at maximum sensitivity. Reduced sensitivity allows ranges of $\times 10$, $\times 100$ and $\times 1{,}000$. There is also provided a jack in series with the milliammeter so that an external circuit may be used if needed, such as a pen recorder, or the instrument may be used as an amplifier for any other purpose.

The output of the instrument may safely be up to 1 mA; although the milliammeter full-scale deflection is 0·1 mA

* Major Banner is a consultant.

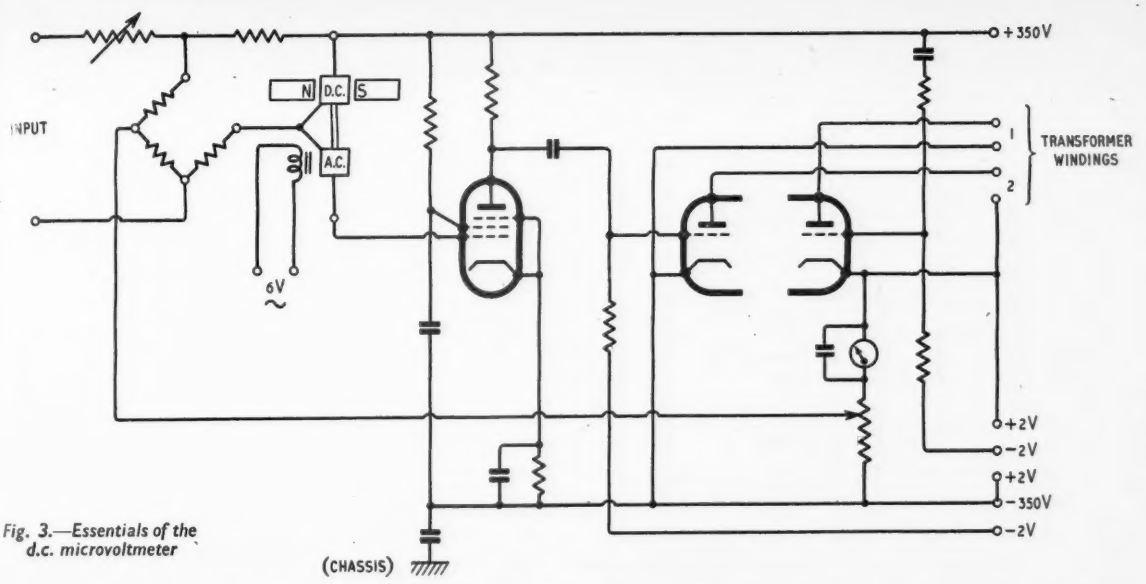


Fig. 3.—Essentials of the d.c. microvoltmeter

no harm results from this overload. When an external circuit is to be used it should preferably be of fairly low resistance—not more than a few hundred ohms. Where a resistance of the order of a thousand ohms necessarily has to be used, then a capacitor of about 2 μF should be added in parallel.

The zero adjustment controls the torsion head of the double coil system, it being sufficiently fine for this to be adequate. The instrument is mechanically robust, but for the highest electrical stability on the most sensitive range it is advisable to mount it where it will be reasonably free from vibration. Where the a.c. mains are liable to violent fluctuations some form of automatic voltage stabilizer may be used to feed the galvanometer. There is no direct connection between the input terminals and the chassis, but no spurious reading is introduced when the negative terminal is earthed. If the positive terminal is earthed then the zero adjustment should be made with the earth connection as it will be in use, then no zero shift will result. The input resistance is 40 ohms and the overall speed of response varies with the range, but it is less than 1 second on all ranges, the time being least with the lower-sensitivity ranges.

The accuracy on the most sensitive range, 10 μV full scale deflection on each side of zero, is within 0·2 μV or 5 per cent. On the other ranges the accuracy is somewhat higher. This instrument is the Pye sensitive d.c. microvoltmeter, and being a low-resistance instrument the microvolt sensitivity is high. The chief applications are thus to low e.m.f. circuits such as those including thermocouples, metal rectifiers for very low illuminations, etc., and as a very sensitive balance indicator for bridges and potentiometers where out-of-balance voltages of as low as 1 μV may be read.

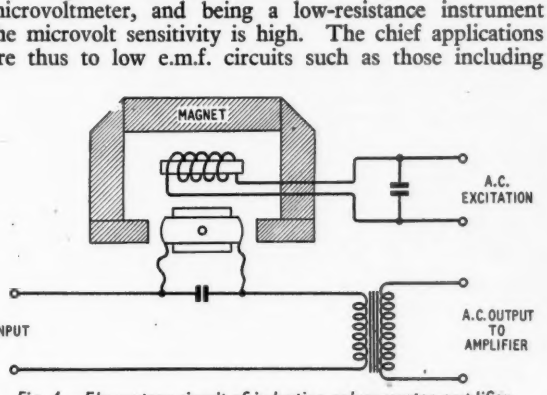


Fig. 4.—Elementary circuit of induction galvanometer amplifier showing the coil system

The second instrument described here is somewhat similar in principle, although intended primarily as a d.c. error detector in feedback systems, and varying considerably in details of construction and operation. This is the instrument converter, or induction galvanometer of the Weston Electrical Instrument Corporation, U.S.A.*

This also employs a moving coil in a permanent magnet system, but there is only one coil and there is also an a.c. electromagnet so that the coil is electrically connected in both d.c. and a.c. circuits. Fig. 4 shows the elementary form without amplification, the primary of the transformer being in series with the moving-coil input circuit.

In this form of instrument the field system could be excited at constant frequency, as is the microvoltmeter described above, in which case the output would be amplitude-modulated by the d.c. input. But a frequency-modulated system is used in this instrument, a nominal frequency of 200 kc/s being fed to the a.c. field magnet coil, but the frequency is modulated by the amount of deflection of the coil. In this case the two a.c. circuits (transformer primary and a.c. electromagnet) are each tuned to resonate at the common frequency. If required, operation in the region of Mc/s is possible. The relatively high frequency used leads to short feedback periods of the order of milliseconds.

Since the magnetic circuit carries h.f. as well as the permanent magnetism, a combination of solid iron and iron powder is used, providing a high overall permeability.

On the application of a small d.c. input the coil tends to rotate slightly and a small e.m.f. is induced in the coil, this e.m.f. being of the frequency to which the system is tuned and which lags 90 deg behind the magnetic flux producing it, the phase relation corresponding to the direction of deflection of the coil. This alternating component is superimposed on the direct current in the circuit and can be used for simple a.c. amplification to any desired extent.

Although the induced e.m.f. is in quadrature with the flux the presence of resistance in the circuit modifies this

* Gilbert, R. W. A sensitive instrument convertor, the induction galvanometer. *Elect. Engng.* (*N.Y.*) **70** (1951), 893-8.

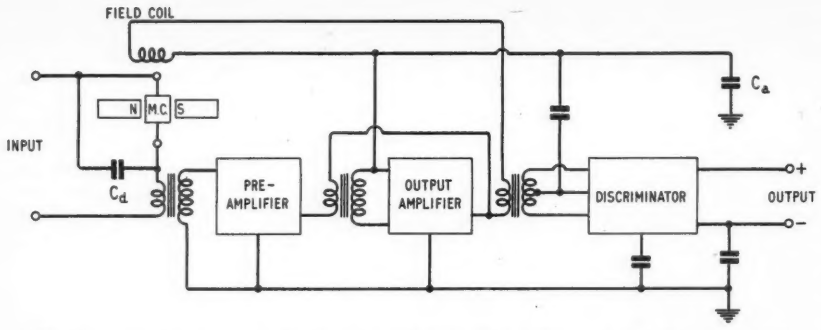


Fig. 5.—Schematic diagram of the induction galvanometer amplifier. C_a and C_d are adjusted to resonate both d.c. and a.c. circuits

and the resultant current lags by an angle less than 90 deg. A torque is produced due to this which appears as a mechanical stiffness of the movement, the torque being considered positive or negative depending on whether the coil circuit is inductive; added capacitance results in a capacitive reactance and a negative torque. This phase angle is thus of consequence in this method of frequency-modulation.

The induced e.m.f. being proportional to frequency, raising the frequency results in the need for a weaker field and the torque effect is proportionately reduced with advantage. For small deflections the induced e.m.f. is closely in quadrature with the field, allowing the frequency-shifting circuit to be used in which a frequency-discriminating rectifier circuit supplies a d.c. output proportional to the frequency shift.

The amplifier, an outline circuit of which is shown in Fig. 5, has a large d.c. output for a small d.c. input and is combined with negative feedback for stability. The instrument then serves as a d.c. error resolver which may be used as part of an automatic potentiometer. It can of course operate a d.c. milliammeter to read in terms of primary or input current, thus acting as an amplifier galvanometer.

Referring to Fig. 5, the pre-amplifier is one half of a double-triode; the other half with a pentode in cascade forms the output amplifier. The input, interstage coupling and output discriminator transformers are resonated to the centre frequency of 200 kc/s by their slug trimmers. In the instrument described the output has a range of 1 mA in an external load of up to 5,000 ohms. Mechanically the galvanometer coil travel is limited and is only 5 sec arc; it has no pointer or mirror and so has a low moment of inertia.

The permanent magnet provides an airgap flux of about 8 kilogauss and the restoring torque provides a restraint requiring a current of 6×10^{-8} A per degree deflection. If the electrical torque be neglected the conversion gain is about 4×10^{10}, based on the ratio of energy developed in the moving coil impedance of about 300 ohms, to the d.c. energy producing it. In practice the circuit is adjusted to cancel the restoring force of the springs, which are actually fine ligaments, so that the gain may be continuously variable between infinity and a high negative value. When adjusted for optimum sensitivity and stability the conversion energy gain is of the order of 10^8.

Acknowledgment is made to W. G. Pye & Co., Ltd., for permission to refer to their instrument.

Railways in France

PROVIDING a background to the review of current electric locomotive practice in France which appeared in the *Electrical Review* of 5th August comes a profusely illustrated brochure of 88 pages issued by French Railways, Ltd., 179, Piccadilly, London, W.1. Salient particulars are presented of the stationary equipment and rolling stock, and of the traffic conditions and research and staffing arrangements of the national railways of the Société Nationale des Chemins de fer Francais.

Reasons for the gradual supersession of steam locomotives (none have been ordered since 1945) by electric and diesel-electric traction include the low efficiency of the former (averaging 5·5 per cent), consumption of high quality coal and heavy upkeep (which limits the average mileage to 62 per day). More recent is the development of 25 kV single-phase traction at the industrial power frequency of 50 c/s for electrification extensions in preference to the 1,500 V d.c. system introduced in 1920. The d.c. system is, however, regarded as unsuitable for French routes on which less than 644 tons of coal to the mile is consumed in a year, in view of the high cost of stationary substations. As a result of successful operation with 50 c/s a.c. on the important Valenciennes-Thionville freight route, based on tests around Aix-les-Bains in 1952, the electrification on this system of the whole north-eastern area is projected.

Four types of locomotive have been developed, viz, with single-phase traction motors, single-phase to d.c. by rotary convertors or ignition rectifiers and single-phase/three-phase transformation, all conversion plant being installed on the locomotives. Diesel-electric locomotives with four times the efficiency of steam and capable of shunting duty for 21 hours a day compared with 12 hours for steam, will also be installed on lines of medium importance. Comparative capital costs of locomotives in 1954 are: Steam, 80 million francs; d.c. 1,500 V, 145 million francs; a.c. 24 kV, 90 million francs.

Institute of Metal Finishing Competition

THE Council of the Institute of Metal Finishing has decided to revive in a modified form the William James Memorial Prize in memory of the first hon. treasurer. The original competition, which was allowed to lapse on the outbreak of the war, was restricted to persons not exceeding 21 years of age (later revised to 25 years), and was designed primarily for students. It is now desired to attract in addition contributions from experienced working electroplaters and metal finishers and the competition is therefore being divided into the following two sections:—Essays from a theoretical or technical standpoint on any aspect of metal finishing or related subject (age limit 25 years); essays based on practical knowledge or experience of any branch of metal finishing or related subject (no age limit). Prizes for each section will be: First prize, 10 guineas; second prize, 5 guineas. Full particulars can be obtained from the hon. secretary of the Institute, 32, Great Ormond Street, London, W.C.1.

VIEWS on the NEWS

By REFLECTOR

SINCE the Chancellor of the Exchequer's announcement of the need for a tighter rein on the country's spending some local authorities have discussed the desirability of modifying the schemes which they have in hand for improved road lighting. Any such move would, I am sure, be false economy. The urgent need for better lighting to reduce the growing number of accidents at night must be obvious to all, but in addition the installation of modern lighting, particularly the conversion of gas lighting to electric, results in many cases in an actual financial saving even allowing for the capital cost of the new equipment. More important still, from the national point of view, there is an appreciable economy in fuel consumption.

* * *

The progress of science is so swift that it frequently passes by before its benefits can be gained by all. The rector of Rand (Lincs) is afraid that this will happen in his village to which electricity has not yet penetrated. In a sermon, reported by the *Northern Echo*, the rector said:

> "Here in our Lincolnshire hamlet we trim our paraffin lamps and read about plans to launch earth satellites and space rockets. Maybe after the trifling venture of reaching the moon has been accomplished the authorities will attempt the gigantic task of bringing electricity a few yards down the lane."

So far I have not had details of the Electricity Board's work on lunar exploration which seems to be implied in this quotation.

* * *

Outstanding impressions which I gained during a few days' attendance at the Geneva Conference on the Peaceful Uses of Atomic Energy (and they appeared to be shared by many others there) were the predominance of the Americans and the very good showmanship manifested in their exhibits; the more sober but evidently practical displays of the United Kingdom Atomic Energy Authority; and the general anxiety to make the Russians feel welcome, combined with strong curiosity about their actual achievements. Much attention was attracted by the Americans' small reactor shown in actual operation and by their two displays of remote manipulation of irradiated elements—a mechanical marvel. The story of developments in Great Britain was well presented but I thought that there was too much reading matter to be properly assimilated in a short time. The models were excellent and I particularly appreciated the attention to detail which resulted in little notices on the surround of one model "Please Keep Off the Grass."

* * *

In some respects the Russian exhibits at the Palais des Nations seemed to be a little reticent and incoherent but I think that much of this was accounted for by the Russians' lack of experience in staging displays likely to appeal to others. Nevertheless the models of reactor stations were well done even if they were not too well explained. The Russian delegates were obviously pleased to meet fellow scientists of other nations, although language difficulties were often encountered, and some of the Russian papers were considered to be informative and valuable. The contribution dealing with the nuclear power station which has been operating for over a year led to the asking of a number of questions. Professor Blokhintsev, who presented the paper, gave generally satisfactory answers but once or twice seemed to be warding off the questions. To be fair, however, it appeared to me that interpretation difficulties might have had something to do with this.

* * *

It is one thing to ward off questions about actual achievements or experience and another to give careful replies to questions on the atomic future. Leaders of the British delegation gave some good examples of the latter kind of tactics at a Press conference held during the Conference. Several journalists put a number of unanswerable questions—that is immediately unanswerable—and were well handled by Sir John Cockcroft and his colleagues. Several attempts were made to get them to set an actual date by which controlled nuclear-fusion power would be available. Sir George Thomson and Dr. J. V. Dunworth explained the problems which had to be solved, e.g., the maintenance of reaction and the provision of materials to withstand the high temperatures encountered. Sir George said that these problems could be solved in a relatively short time, in a generation perhaps.

* * *

How often does one settle down in bed at a hotel to find that the light over the wash-bowl, controlled by a local switch, has been left on, necessitating a reluctant rising and subsequent readjustment. In my Geneva hotel I found that the switches for both the wash-bowl and bed lights were together at the bed-head—a very sensible arrangement which should be generally followed. The switches, by the way, were of a silent micro-break pattern.

* * *

Fifty years ago almost to the day the *Electrical Review* caustically commented on the Parliamentary procedure which resulted in the demise of the Administrative County of London Power Bill, through mere efflux of time, after a ten-week hearing before Committees of the two Houses. Reports of the proceedings seem to indicate some lack of balance on the part of opponents of the Bill between anxiety to preserve local interests intact and solicitude for promoting a greater supply of electricity to a greater number of consumers. Lack of faith in the future of electricity contrasted curiously with the justified optimism of the present time. One eminent electrical engineer, as expert witness, risked the opinion that there was "certainly no reason to suppose that London manufacturers would rush for a supply of electrical energy" and said he "could not see how a power station could get a load factor of 34 per cent," as expected by the promoters.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Fuel and Power has appointed **Mr. Forbes Jackson,** M.I.Mech.E., M.I.E.E., as a part-time member of the Southern Electricity Board. Mr. Forbes Jackson retired from the position of deputy engineer-in-chief to the London County Council a few months ago.

The Minister has re-appointed **Mr. H. G. Partridge,** M.A., of Cardigan, as a part-time member of the South Wales Electricity Board, and he has also appointed **Councillor H. Preece** of Coven, Wolverhampton, to be deputy chairman of the Midlands Electricity Consultative Council.

Mr. Thomas G. Ellison has been elected chairman of George Ellison, Ltd., Tufnol, Ltd., and Alfred Ellison, Ltd. He succeeds his father, Mr. George Ellison, whose death was reported in our 22nd July issue. Mr. George Ellison and Mr. John Ellison, brothers of the new chairman, and Mr. Arthur E. Skan continue as directors of all three companies.

Mr. T. G. Ellison

Brigadier F. C. Wallace, D.S.O., M.C., has joined the board of Decca Radar (Canada), Ltd.

Brigadier Wallace was a leading figure in the Canadian radar field during the war. At that time he was the Director of the Radio Division, National Research Council, and was responsible for radar production at Research Enterprises, Ltd., a Crown company, as well as occupying a key position in the military radar field.

Mr. James I. Plenty has been appointed manager of Merthyr Motors, Ltd., the large transport organization of Hoover (Washing Machines), Ltd., Merthyr Tydfil. Since the formation of the company in 1950 Mr. Plenty has been deputy manager.

A number of changes have recently been made in the membership of the Technical Sub-Committee of the **Television Advisory Committee.** The chair is occupied by the engineer-in-chief of the Post Office, Brigadier L. H. Harris. The Post Office representative is Captain C. F. Booth (assistant engineer-in-chief), in place of Mr. H. Faulkner, and Mr. A. B. Howe, assistant head of the B.B.C. Research Department, now represents the Corporation in place of Mr. R. T. B. Wynn. Dr. Willis Jackson has resigned. Three additional members have been appointed. They are Mr. L. H. Bedford (Marconi's Wireless Telegraph Co., Ltd.), Mr. T. M. C. Lance (Cinema-Television, Ltd.), and Mr. E. P. Wethey (Kolster-Brandes, Ltd.).

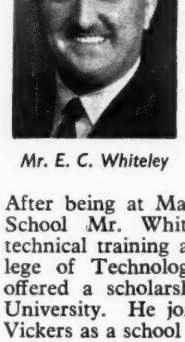
Mr. E. Watt has been appointed manager of the Chester Branch of British Insulated Callender's Cables, Ltd., as from 1st September. Mr. Watt was educated at Old Trafford Technical School and in 1917 joined the Manchester Branch sales staff of British Insulated Cables, Ltd., and in this capacity he has had a long and close association with local heavy industry, collieries and the electrical trade.

Mr. E. Watt

Mr. A. J. S. Brown has been appointed a director of the Chloride Electrical Storage Co., Ltd.

Mr. W. T. Trace (W. H. Trace & Son, Ltd.), who has represented N.E.C.T.A., Ltd., on the Electrical Fair Trading Council, has resigned, and **Mr. J. G. Briggs** (Electrical Installations, Ltd.), and **Mr. H. S. Wathes** (T. H. Wathes & Co., Ltd.), have been appointed to represent N.E.C.T.A., Ltd., on the Council.

Mr. E. C. Whiteley has been appointed by the Metropolitan-Vickers Electrical Export Co., Ltd., as manager, Middle East Division, as from 1st May last. He retains his responsibilities in connection with the petroleum industries, for which he has been the company's special representative since 1949.



Mr. E. C. Whiteley

After being at Manchester Grammar School Mr. Whiteley received his technical training at Manchester College of Technology, where he was offered a scholarship to Manchester University. He joined Metropolitan-Vickers as a school apprentice in 1920, and after specializing for some time in electric traction transferred to the sales side. In 1930 he was appointed M-V's technical representative in Malaya and during the next twelve years travelled extensively in the Far East. He then spent three years in Australia as works engineer and acting works manager of the Australian General Electric Company's Works at Richmond, Melbourne.

Mr. Whiteley returned to England in 1945 to take up duties in connection with Metropolitan-Vickers' wide interests in the petroleum industry.

Mr. L. J. Curtis, previously manager of the Bournemouth branch of Brown Brothers, Ltd., has been promoted to an appointment at their head office in connection with their garage equipment interests. **Mr. A. S. Renwick,** who has managed the Stoke-on-Trent branch since 1938, is appointed manager at Bournemouth. **Mr. S. J. Hillier,** formerly assistant manager at Wolverhampton, takes over the management of the branch at Stoke-on-Trent.

Major E. H. W. Banner, T.D., M.Sc., M.I.E.E., M.I.Mech.E., F.Inst.P., M.Cons.E., author of the article on "D.c. Galvanometers" in this issue, studied at the University of Birmingham after the 1914-18 war and graduated with B.Sc. and M.Sc. degrees in electrical engineering. He then spent three years at the G.E.C. Research Laboratories, five years with Ferranti, Ltd., on instrument design, and three years with Salford Electrical Instruments, Ltd., on technical publicity and instrument development. In 1937 he was given a special post with the War Department as advisory electrical officer to the Armaments Inspection Department, and later was recalled from the Regular Army Reserve of Officers and served until 1946, mainly in staff posts with the Ministry of Supply. Major Banner is now a consultant on electrical and mechanical engineering subjects.

Major E. H. W. Banner

Mr. C. E. G. Bailey, M.A., M.I.E.E., who for some time has been a consultant to the Solartron Electronic Group, Ltd., has been appointed technical director of Solartron Electronic Business Machines, Ltd. He will also act in a general advisory capacity on research and development work to the group. Mr. Bailey was educated at Gresham's School, Holt, Norfolk, and was an Exhibitioner of Balliol College, Oxford, where he read physics. After three years with the

Gramophone Company (now Electric & Musical Industries, Ltd.) as a radio engineer, he joined the Plessey Co., Ltd., as the company's first radio designer. He left the Plessey Co. to join the Philips group, first in England, then in Holland, where he was in charge of the Philips communications laboratories at Hilversum. He escaped to England during the German invasion of Holland and supervised a laboratory group for Mullard, Ltd. He was largely concerned with the radar counter-measures unit of the British Government's Telecommunications Research Establishment. After the war he directed, in Sweden, a laboratory of the Royal Swedish Air Board, and in 1952 set up as an independent consultant.

Mr. William Paynter has joined Mervyn Instruments of Woking as works manager. After nearly thirty years of experience with E. K. Cole, Ltd., in their main factory and at various branches Mr. Paynter held the post of production manager of the Special Products Division at Southend.

Mr. W. Paynter

As a result of the activities of the **London Area Golf Committee** during the Electrical Power Convention at Brighton the Electrical Industries Benevolent Association has benefited to the extent of about £1,575; last year the total was £1,230.

The **Electrical Industries Benevolent Association** informs us that in connection with a competition being arranged by the *Evening News* at the 1955 Radio Show at Earls Court, the whole of the penny entrance fees are being donated to the Association.

OBITUARY

The death occurred on 11th August, after a very short illness, of **Mr. H. Kelvin Parsons,** managing director of Gent & Co., Ltd., Leicester, at the age of 53.

[Photo: *Leicester Mercury*

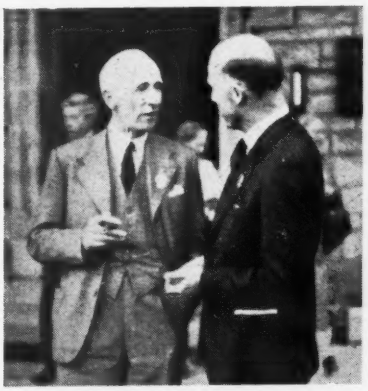
The late Mr. H. K. Parsons

Mr. Parsons was particularly well known in the electrical and horological industries; he was a Freeman of the City of London, a Fellow of the British Horological Institute and an associate member of the Railway Signal Engineers. He was educated at Uppingham and Cambridge and joined Gent & Co. in 1923 becoming a director in 1931 and managing director in 1946. He is survived by his wife and a daughter.

Mr. Frederick Gaston Penny, managing director of International Combustion (Holdings), Ltd., and of its subsidiary, International Combustion, Ltd., whose death we briefly recorded in our last issue, began his engineering career with the British Westinghouse Co., at Trafford Park. He joined International Combustion, Ltd., in 1926 as manager of the field staff. Later he was appointed chief engineer and general manager and was elected to the board of directors. He became managing director in 1951. He was also chairman of Aberdare Cables (Holdings), Ltd., and South Wales Switchgear, Ltd.

The late Mr. F. G. Penny

Mr. T. Lawrie.—The death occurred suddenly in Edinburgh on 13th August of Mr. Thomas Lawrie, C.B.E., M.A.(Cantab.), M.I.E.E., M.I.Mech.E., general manager of the North of Scotland Hydro-Electric Board. Mr. Lawrie was born at Laurencekirk, Kincardineshire, in 1901, and after attending the Leighton Park School, Reading, went to Cambridge University (King's College). He received engineering training in the United States and Scotland and was then with the English Electric Co., Ltd., from 1925 to 1927, working in the company's hydro-electric section. In 1927 he became engineer and secretary to the Power & Traction Finance Co. and concurrently, from 1930, secretary of the Galloway Water Power Co. and the Sudan Light & Power Co. From 1940 to 1943 he was in the R.N.V.R. (lt.-cdr.) and saw service at Dunkirk and Dieppe. He was released on the formation of the North of Scotland Hydro-Electric Board to become its first secretary. He held that position until 1948 when he was appointed general manager.



In this picture the late Mr. T. Lawrie (left) is seen in conversation with Mr. W. S. Steel (B.T.H.) at the recent I.E.E. Summer Meeting

Lord Ramsden. — The death occurred on 9th August at the age of seventy-two of Lord Ramsden, O.B.E. As Sir Eugene Ramsden, Bt., he became a director of the Yorkshire Electric Power Co., in 1940. Two years later he also joined the board of British Insulated Cables, Ltd., and upon the merging of the businesses of B.I. Cables and Callender's Cable & Construction Co. in 1945 into the present British Insulated Callender's Cables, Ltd., he continued to serve on that board until his retirement owing to ill-health in June, 1954. He was created a baron in 1945.

WILL

Lt.-Col. G. F. Falk, T.D., M.I.E.E., a director of Falk, Stadelmann & Co., Ltd., and of Wandleside Cable Works, Ltd., who died on 24th May last, left £39,354 gross (£35,473 net).

CONTRACT PRICE FORMULÆ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 13th August is deemed to be 162s 0d. The "cost of materials" figures are:—

For electrical machinery and equipment the Board of Trade index figure published on 13th August is 182·2.

For turbo-generating and allied plant: Materials used in mechanical engineering industries, 166·1; blast furnaces and iron and steel smelting and rolling (40 and 41), 149·5. The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin,* 12th August) is 4s 5¼d per lb. Outstanding contracts covered by the B.O.T. intermediate products index: The index figure for intermediate products (13th August) is 376·3.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £171 0s 0d
COPPER, H.C. Electro	ton £359 0s 0d
Fire Refined 99·70%	ton £358 0s 0d
Fire Refined 99·50%	ton £357 0s 0d
COPPER Tubes ..	lb 3s 5½d
Sheet	ton £427 10s 0d
H.C. wire and strip ..	ton £403 0s 0d
LEAD, English ..	ton £105 0s 0d
Foreign	ton £104 0s 0d
MERCURY	flask £95 0s 0d
TIN, block (English) ..	ton £750 10s 0d
ZINC, G.O.B. Foreign	ton £89 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 8¾d
Sheet	ton £335 5s 0d
Wire	lb 3s 4½d
PHOSPHOR BRONZE Wire	lb 4s 11½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 39½d—39¾d

Australian Electrical News

The assistant director of the Associated Chambers of Manufactures (Mr. R. W. Anderson) alleges that British manufacturers of electrical switchgear have "dumped" their products into Australia "to injure Australian manufacturers." Speaking in Canberra recently, Mr. Anderson said that the established case of dumping on the Australian market involved part of a large contract for electrical switchgear, required by an Australian local authority. The highest Australian price was no less than 78 per cent above the lowest British price. For several years, some British manufacturers had quoted much lower prices than the average Australian prices to establish themselves on the Australian market. Then, after several contracts at low prices, the manufacturers, on subsequent contracts for similar switchgear, raise their prices to somewhere near the average being quoted by other manufacturers. Mr. Anderson went on to state that there was "a deliberate pattern of quoting uneconomical prices to the detriment of Australian manufacturers."

Australian manufacturers of electrical switchgear advised the Government about twelve months ago that some United Kingdom manufacturers were quoting extremely low prices in certain instances where Australian competition was being met. Mr. Anderson is now asking the Government to investigate the connection between manœuvring of prices against Australian competition and recent allegations that British manufacturers operated a price ring to force prices up when there was no Australian competition.

Following the recent visit of Mr. H. G. Horsley, general manager of Crompton, Parkinson (Australia), Ltd., of Five Dock, Sydney, to the parent organization in Britain, a decision has been reached to construct, at Campbelltown, New South Wales, a new £500,000 plant for the manufacture of the company's electrical products. This is in addition to the company's existing modern plant at Five Dock, and ultimately it will employ several hundred workers. A site of 265 acres has been purchased, and work on the new factory is scheduled to commence within the next few months. It is anticipated that it will be completed some time in 1956.

Ellis & Clark (Holdings), Ltd., is to be floated shortly as a public company for Ellis & Clark, Ltd., old-established Adelaide electrical manufacturers and distributors. It is understood that a public issue of £30,000 in 5s shares will be made, taking paid capital to £80,000. New funds will be used to expand the company's switchboard section, for which an additional factory is planned, while it is possible that an associate company holding switchgear agencies may be absorbed.

The State Electricity Commission of Victoria announces that electric lawn mowers of up to one h.p. must not be marketed in that State in future unless they are approved by the Commission's board. In addition, low voltage single-phase transformers of not more than 1 kVA must be approved by the board before they can be sold or hired, although it is stated that this provision will not take effect until 1st February.

Geelong (Victoria) trams are to be scrapped this year and replaced by buses. This is likely to relieve the Electricity Commission, which runs the trams, of a liability of about £100,000 a year. Last year the Melbourne Tramways Board showed a deficit of £249,000, but only recently trams were reintroduced into the principal Melbourne streets.

Street Lighting Notes

Mr. C. C. Smith, city lighting engineer of LIVERPOOL, in his annual report, states that conversion of street lighting from gas to electricity will be a major item of the work of the department during the next ten to fifteen years. About 11,000 gas lamps will be replaced by 15,000 electric lamps at a cost of £600,000. There are at present 34,591 lighting positions, including the following:—Sodium, 3,898; fluorescent, 67; mercury, 39; cold cathode, 6; tungsten, 19,681; and gas, 10,900. The total number of lamps now operated by remote or central control from 71 control points is 6,029, of which 4,098 are operated by individual units from 33 transmitters and 1,931 by 136 group units from 38 master switches. The total number of metal filament electric lamps used during the year was 109,501, averaging 3·55 per holder per annum, and the number of sodium tubes used was 4,958, an average of 1·29 per lamp per annum.

PORTSMOUTH Roads, Works and Drainage Committee has approved street lighting schemes for 1955-56 estimated to cost £15,700.

The Ministry of Transport has approved a number of street lighting conversions from gas to electricity in ROWLEY REGIS for execution during the current financial year, including High Street, Old Hill, Garratts Lane and Powke Lane (£4,798), Gorsty Hill Road (£1,481), Station Road, Highfield Road and Holly Road and parts of Waterfall Lane and Perry Park Road (£5,540), and Corngreaves Road, Belle Vale (£1,717).

DEAL Corporation has approved a scheme, estimated to cost £4,710, for the conversion of street lighting from gas to electricity.

The Ministry of Transport has given preliminary approval to the scheme of SKIPTON U.D.C. for improved lighting of trunk roads in the urban area, but before tenders can be invited, the type of columns and equipment to be used have to receive the approval of the Royal Fine Art Commission.

SOUTHPORT Lighting Committee has accepted tenders for a £35,000 street lighting scheme, to cover 46 streets in the borough. It is intended to erect 267 sodium-type lamps in Class A roads and to convert 583 gas lamps to electricity in Class B roads.

Approval was given by the BRISTOL Planning and Public Works Committee for the spending of an additional £1,600 for the provision of 15 new fluorescent lamps at the centre of the city.

SCARBOROUGH Town Council has received sanction to borrow £15,550 for the conversion of street lighting from gas to electricity.

STOCKTON-ON-TEES Town Council has received loan sanction for £12,420 for street lighting in the Haverton Hill Road area.

SUTTON COLDFIELD Highways Committee reports that the Minister of Transport and Civil Aviation is prepared to give preliminary approval to the provision of sodium street lighting along trunk road A.38 from the borough boundary to Jockey Road. Tenders for the necessary work are to be invited.

BUXTON Corporation is recommended to accept the tender of the North Western Electricity Board, amounting to £10,300, for the final phase of the conversion of street lighting from gas to electricity.

ABERDEEN City Council proposes to improve the street lighting at Alford, at an estimated cost of £1,352, and on the North Deeside Road (£2,615).

A £190,000 plan to convert street lighting in DUDLEY from gas to electricity during the next five years is being considered by the Town Council. If the plan is approved, 19 main roads in the town will be converted from gas to electricity in the first twelve months at a cost of £40,000.

LEICESTER City Council is to spend £10,000 during the first year of a ten-year £100,000 programme for converting all gas street lamps to electricity.

BRIERLEY HILL (Staffs) U.D.C. is recommended to approve a scheme for main road lighting by electricity.

CHESTER City Council is being recommended to approve the conversion of street lighting at Hoole from gas to electricity at a cost of £11,294.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Current Transformers

WITH regard to the letter from Mr. L. B. S. Golds published in the *Electrical Review* of 5th August, I am aware that tuned rejector circuits can be used to improve test set wave-form and agree that they are effective; but if such apparatus is not available, resistance control will still have to be used. It is important that test sets giving identical wave-form are used in the area, otherwise relay setting discrimination may suffer. If a pure wave-form set is used at all, it must be used for all timing tests.

I am not sure that I agree with Mr. Golds that a pure 50 c/s wave more nearly simulates fault conditions. A fault may cause currents in the relay circuits anything but sinusoidal, particularly with heavy faults and current transformers running into saturation. A pure wave-form injection set may well be the answer to the precise determination of current transformer magnetization curves. The use of variable voltage test transformers together with rectifier instruments is only acceptable in that it gives pessimistic figures and therefore has an included factor of safety. Moreover it is quite reasonable for the purpose of comparison between different c.t.'s.

Bristol. J. H. TOULE.

"East African Survey"

I READ with great interest the useful and timely article entitled "East African Survey," in your issue of 17th June. The article is, however, in error in stating boldly that Kenya is supplied with electricity by the East African Power & Lighting Co., Ltd., since in fact the Nyeri Area, shown on the map accompanying the article as an electricity supply centre to the north of Nairobi and north-east of Nakuru, but not named, is supplied by a publicly-owned electricity undertaking having an area of supply in the region of 170 square miles.

Although a comparatively small undertaking it is actually bigger, in terms of energy output as well as supply area, than certain others mentioned in the article and is at this moment in process of extending its power station by a further 1,000 kW of hydro-electric plant, which has been supplied by British manufacturers.

Nyeri is, regrettably, well known to-day as a prime centre of the Mau Mau organization, but in spite of the handicaps imposed by the emergency the sale of energy in the area has more than doubled since 1952, and can be expected to grow even faster when conditions settle back to normal.

Plans are at present in hand for the inauguration of a second publicly-owned undertaking at the coastal holiday resort of Malindi, and other similar small schemes are being studied.

Nairobi, Kenya. A. BATESON.

F.B.I. Scholarships

The annual report of the F.B.I. Overseas Scholarships Scheme for the year ended 31st March last shows that the scheme, which provides practical training in Britain for specially selected young graduate engineers from developing countries overseas, is expanding rapidly. Between the end of 1950, when it began, and the end of the period under review 80 scholarships had been awarded, 64 scholars had actually arrived in this country and of that number 23 had already completed their training and returned home.

Since the date of the report a further six scholars have arrived and 44 more are expected by the end of the year. It is hoped that within a short time it will be possible to award 150 scholarships each year, and 107 are in fact now being offered for award during 1956. The countries from which F.B.I. scholars had come up to the end of the period covered by the report were Argentina, Australia, Chile, Colombia, Cuba, India, Iran, Mexico, Pakistan, Peru, the Sudan and Uruguay; but since then scholarships have also been awarded in Brazil, Iraq, Ceylon, Malaya and Rhodesia, and are being offered in a number of other countries.

The scholarships are at once a form of technical assistance to the countries concerned and a means of familiarizing their future leaders of industry with British equipment and methods, so that they may be predisposed to "Buy British." They represent, in the words of the report, "a long-term investment in our future exports."

The normal type of scholarship provides training for two years in a British engineering works, though provision is also made for shorter periods of specialized training. The present report also includes the announcement of a new type of scholarship, to be administered jointly by the F.B.I. and the British Council, for young university professors from Latin America. This type of scholarship will cover a period of 20 months in this country, equally divided between an engineering works and a university. It is hoped that on their return these professors will arouse interest in British engineering achievements among their pupils, and a desire for training in Britain.

The cost of the normal type of scholarship, which may be as much as £1,000 each, is met partly by contributions from the engineering works which accept scholars for training and partly by a Government grant, with the F.B.I. itself providing the administrative staff and meeting certain overhead expenses. The report includes a list of 73 firms or organizations already participating in the scheme. It is noted that more than half of the young men who have received awards of scholarships are spending some time in the works of electrical manufacturers.

In a foreword, however, the Chairman of the F.B.I. Overseas Scholarships Committee, Sir Arthur P. M. Fleming, C.B.E., D.Eng., writes: "Many engineering companies have not yet opened their doors to overseas trainees, although they could readily provide excellent training facilities, either alone or in association with others. . . . Companies engaged in export are the most direct beneficiaries of the scheme, but all concerned with engineering will benefit from it in the long run. I hope therefore that all engineering organizations, large or small, privately or publicly owned, manufacturing, consulting or contracting in all branches of engineering, will give the F.B.I. Overseas Scholarships Scheme their maximum possible support."

"No Climb" Lighting System

We recently saw a demonstration of a sytem of industrial lighting making use of a planned arrangement of fittings and an extendable rod for changing lamps or bringing the reflectors to floor level for cleaning. This represents a development by Cable Strippers, Ltd., Leighton House, Potters Bar, Middlesex, of their earlier "no-climb" lamp changer. The ceiling mounting incorporates a short conical skirt to assist in centring a fitting being located and fixed from a floor perhaps 30ft below. The extendable rod has a three pronged grab opened by a handle at its base, for gripping the periphery of the reflector.

A certain amount of practice in the use of the grab and rod seems essential but once the technique is mastered considerable economies in time and manpower should result. The same rods can also be fitted with the claw ends for lamp changing. Such places as school halls and churches, where high mountings are common, would appear to be useful fields of application, in addition to industrial establishments.

The component parts of the system will be available, we understand, in September.

NUCLEAR POWER

Canada's Atomic Power Station

A preliminary technical description of Canada's first electricity-producing atomic plant (N.P.D.) has been released by Atomic Energy of Canada, Ltd., the Crown company charged with atomic research in Canada and which operates the Chalk River, Ontario, atomic establishment. Costing between $13,000,000 and $15,000,000, the experimental plant is expected to produce about 20,000 kW. The station will be situated at the site of the huge hydro-electric installation on the Ottawa River near the village of Des Joachims, Quebec, 150 miles north-west of Ottawa. The plant is expected to be in operation in mid-1958.

The probable form of the plant and details of its design are being submitted to the International Conference on the Peaceful Uses of Atomic Energy at Geneva.

N.P.D. will not produce electricity at a competitive cost, but its construction will provide scientists with the information necessary to enable them to build a plant that can compete with coal-burning electricity stations.

The Canadian General Electric Co. will be responsible for the detailed design, engineering and construction of the reactor, and the site, buildings and the turbines and electric generators will be provided by the Ontario Hydro-Electric Power Commission at a cost of between $3,000,000 and $3,500,000.

The Ontario Commission will operate the plant and distribute the electricity through its Ontario power network. Natural uranium, possibly enriched with plutonium, will be used as fuel in the experimental reactor, the heat-producing fuel consisting of about 200 uranium rods contained in a vessel about 10ft in diameter and 10ft high. Each rod will be sheathed in a tube of zirconium, a metal with a relatively high melting point. Uranium rods in the three research reactors at Chalk River are sheathed in aluminium tubes.

The ZEUS Reactor

A full scale, very low-power model of the Dounreay type fast reactor has been built at Harwell and should be in operation before the end of this year. It has been named ZEUS (Zero Energy Uranium System) and will provide data relating to the design and operation of the experimental reactor which is to be installed at the Dounreay experimental power station. ZEUS has a fast reacting core containing only the fuel, its canning material, and the coolant. There is no moderating material like heavy water or graphite to slow down the neutrons. However, being a full scale model of an actual power reactor, it is much larger than ZEPHYR. The fuel is uranium highly enriched in uranium 235 (from the diffusion plant at Capenhurst), instead of the plutonium fuel used in ZEPHYR. The fuel is in the form of long tubes which are mounted vertically to form a hexagonal shaped core.

The core is surrounded by an envelope or blanket of natural uranium, the purpose of which is to absorb the neutrons from the core and so produce plutonium. The Dounreay reactor and ZEUS are both breeder reactors in the sense that the amount of plutonium produced in the reactor should exceed the amount of uranium 235 burned in the core. It is not expected that the breeding margin will be as high as it was in ZEPHYR, where the amount of fresh plutonium produced in the reactor was found to be about double the amount consumed in the core. The operating power level of ZEUS will be only about one millionth of that of the proposed Dounreay reactor. This will be sufficient for the experimental studies, which are to be carried out on ZEUS, without leading to many of the engineering difficulties associated with operation at high power. Staff from the Industrial Group of the Atomic Energy Authority who will be responsible for running the high power reactor at Dounreay will take part in the operation of ZEUS.

The original purpose of the development of fast reactors was the efficient utilization of the uranium made possible by breeding. Because of the complex technical problems which they pose, fast reactors will not play a prominent part in the early stages of the utilization of atomic energy, but when they do come into widespread use they will make it possible for a substantial supply of fissile material to be obtained economically from a relatively modest supply of uranium.

World's Reactors

A survey made by the American Atomic Industrial Forum of nuclear power developments in thirty-two countries shows that reactors now exist in the following countries:—29 in the United States, five in Great Britain, two in France, two in Canada, and one each in the Soviet Union, Norway and Sweden. In addition, an American built "swimming pool" type reactor was assembled in Switzerland for the International Conference at Geneva. Many of the other reactors which have been built are described in papers being delivered at the Conference. The report says that it is generally assumed that additional reactors are in existence and under construction in the Soviet Union, but the Soviet Government has not announced them; the Soviet Union failed to respond to the survey.

Of 20 reactors under construction, nine are in the United States, three in Great Britain, three in Europe, and one each in Australia, Belgium, Canada, India and the Soviet Union. Britain plans to build 22 reactors and the United States 16. The survey also includes information on organization and other phases of the atomic energy programme in the countries covered.

T.I. "Atomic" Publication

In connection with its exhibits at the Geneva Conference Tube Investments, Ltd., produced a handsome brochure, in English with a parallel French translation, setting out the group's contributions to the development of the peaceful uses of atomic energy. This shows the scope of the T.I. group's activities; it also contains a list of the exhibits and of the member-companies of the group.

X-Ray Therapy

The Science Museum has just completed a small group of exhibits, relating to linear electron-accelerators, in the Atomic Physics Collection.

Recent developments in electronic techniques have enabled electrons to be accelerated to very high speeds without the direct use of correspondingly high voltages.

For purely research purposes the cyclic accelerators such as the betatron and synchrotron are perhaps the most outstanding in this field, but for the production of penetrating X-rays for hospital radio therapy the travelling-wave linear electron-accelerator has great advantages, and is being installed in an increasing number of hospitals in the United Kingdom.

The Science Museum exhibit comprises sectioned parts of an actual accelerator, presented by Mullard, Ltd., a most ingenious mechanical model illustrating the principle of the travelling-wave accelerator, lent by the Metropolitan-Vickers Electrical Co., Ltd., several diagrams showing the construction and operation of these accelerators, and a group of photographs showing them in use in Hammersmith Hospital and in the Megavolt Treatment Unit at Newcastle-upon-Tyne.

Atomic Energy Conference

Some of the Papers and National Exhibits

AT the opening session in the Palais des Nations, Geneva, of the International Conference on the Peaceful Uses of Atomic Energy the President Dr. Homi J. Bhabha (India) spoke of three great epochs in the advance of humanity. The first was based entirely on human or animal labour; the second was the industrial, mechanical, era in which we still were; and the third, the age of atomic energy, was just beginning.

Dr. Bhabha urged the need for rapid development of the new power to maintain our civilization and develop the backward countries. He outlined what had already been done and said that the world would reach a stage which would necessitate an international society in which the major states agreed to sustain peace. He predicted that within the next two decades a method would be found for liberating atomic fusion energy in a controlled manner; when that happened the energy problems of the world would be solved for ever.

Following the presidential address survey papers were presented on the estimated power needs and alternative power sources during the next half-century. The first was a United Nations paper presented by Mr. N. B. Guyol, "World Energy Requirements in 1975 and 2000." It was shown that in 1952 world energy consumption was the equivalent of $10{\cdot}2^6$ million kWh; by 1975 the requirements would be $27{\cdot}0^6$ million kWh and by 2000 84^6 million kWh. The estimates were based on the assumption that there would be no major wars or economic upsets. If international economic co-operation prevailed the requirements would far exceed the estimates.

It was considered that if the direction of nuclear science was solely towards electricity production no more than a fifth of the world's energy would be obtained from nuclear sources by the year 2000; if attention were given also to the production of low-cost heat fissionable materials could provide as much as three-quarters of the energy needed by 2000.

Papers from France (P. Ailleret), the United Kingdom (E. A. G. Robinson and G. H. Daniel) and the United States (E. S. Mason) supplemented the U.N. survey. The British contribution dealt with "The World's Need for a New Source of Energy." Attention was drawn to the rapid rate at which existing fuel resources were being used up. It was estimated that by 2025 the total energy requirements would be the equivalent of 12·1 milliard tons of coal, of which coal itself could provide only 2·3 milliard tons, hydro-electricity 2·2 milliard and oil and natural gas 7·6 million.

The authors said that the development of nuclear energy for power production had begun none too soon. The relative costs of producing electricity at thermal and nuclear power stations was of critical importance. It would appear to be desirable that by the end of this century a large proportion of the production should be in nuclear stations.

At the next session the individual power needs of the following countries were dealt with:—India (H. J. Bhabha), Brazil (E. Mottar Rezende), Yugoslavia (A. Blazek and others), Australia, Belgium (R. Van Mele), Czechoslovakia (A. Sevcik), Japan (K. Aki) and Argentina (G. Mendivelzua).

U.S. Fixes Prices of Materials

During the first day of the Conference the United States Atomic Energy Commission chairman (Admiral Lewis L. Strauss) made two announcements. The first was that his Commission had fixed the price for enriched uranium "leased" for research purposes and sale prices for normal uranium and heavy water. The charge for the lease of uranium enriched to 20 per cent in U235 for use in research reactors under the bilateral agreements between the United States and friendly nations for co-operation in the civil uses of atomic energy would be $25 per gram of contained U235. The sale price of heavy water would be $28 per lb and that of normal uranium metal $40 per kg.

Admiral Strauss also announced the establishment by Mr. Henry Ford II and his brothers of a fund of $1 million to provide an annual "Atoms for Peace Award" of $75,000 to an individual or group of any nationality who or which was adjudged to have made the greatest contribution during the year to the peaceful uses of atomic energy.

Russian Power Station

Sir John Cockcroft presided at a session under the general heading, "The Building of a Nuclear Energy Enterprise." A paper on "The First Atomic Power

M. Max Petitpierre, President of the Swiss Confederation, opens the International Conference on the Peaceful Uses of Atomic Energy

Station in the U.S.S.R. and the Prospects of Atomic Power Production" (D. I. Blokhintsev and N. A. Nikolaev) was presented by Mr. Blokhintsev. This described in great detail with the aid of pictures and diagrams the construction and operation of a 5,000 kW plant deriving its energy from a pressurized water-cooled uranium-graphite reactor with a rated heat generating capacity of 30,000 kW. The plant has been operating since June, 1954.

The reactor has a total charge of 550 kg of enriched (5 per cent U235) uranium. There is a two-circuit system of heat transfer by which, it is claimed, radioactive contamination of the turbine and its connections could be avoided. Water in the first circuit under a pressure of 100 atm gives up its heat through a system of heat exchangers to the water in the second circuit which is evaporated and operates the steam turbine. At peak output the three steam-generator groups produce 40 tons of steam an hour at 12·5 atm pressure and 255-260 deg C.

The authors stated that since it was started up the station had been tested in various operation conditions and had produced 15 million kWh of electricity. There had been no failure of the fuel elements and the channels (of which there are 128) are easily removed. The elements were replaced once in two months, requiring two to three days. It was claimed that there was great stability of operation and the automatic control and breakdown protection systems worked without a mishap. While the production cost per kWh was higher than that of a large thermal power station it was comparable with that of a low-power (1-5,000 kW) thermal station.

The paper referred to the consideration of an atomic power station of 100,000 kW and in the ensuing discussion Mr. Blokhintsev said that a station of this size would be ready in a year's time. It was not proposed to build a number of 5,000 kW stations.

Capital for Development

Studies of the capital investment required for the development of nuclear power were made by J. M. Hill and S. W. Joslin (United Kingdom) (presented by the latter) and by W. K. Davis (U.S.A.). The first paper referred to the costly research and development which preceded the construction of the two Calder Hall reactors and said that they would need no further development effort apart from that necessary to overcome minor troubles which might arise during commissioning. It would be possible confidently to order duplicates of these reactors at a cost of about £15 million for a station consisting of a pair of reactors with associated generating plant and auxiliaries.

C.E.A. Programme

When construction started two years hence on the nuclear stations for the Central Electricity Authority it should be possible to do it at a capital cost of about £120/kW installed or, allowing for the cost of the fuel, £150/kW. The figures were based on the possibility of achieving perhaps 150 MW from a station costing in the neighbourhood of £18 million—about twice the cost of the conventional fuel-fired station. As the stations would be built for the C.E.A. by private industrial organizations construction and payment for them would be very much a normal commercial undertaking. It would not be long before it would be possible to purchase power reactors from firms in the major atomic countries.

It was probable that the capital cost of a nuclear station would rapidly fall to perhaps 50 per cent above conventional cost. The rate of interest, the expected return on capital and the cost of conventional fuel were also important. By buying a complete reactor and making a contract for the supply of fresh fuel and the reprocessing of irradiated elements any country should be able to obtain a full-scale power station for perhaps £20 million or half that sum if a smaller system with a somewhat higher cost per kW were acceptable.

A more industrialized country, not wishing to undertake the full development work, might prefer to build its own reactors under licence. About a third of the cost

would be represented by the generating machinery and normal ancillaries. The second part of the task would be the provision of the special reactor materials, i.e., graphite and heavy water if the reactors operated on natural uranium. The Calder Hall type of reactor needed over 2,000 tons of high quality graphite. If graphite-moderated reactors were built in substantial numbers the demand for both graphite and heavy water would greatly outpace supply.

On the engineering side the substantial requirements for high quality welded vessels, special compressors and electrical machines might cause difficulties until the production means were expanded.

Many countries might wish to develop and design their own reactors and the authors recounted United Kingdom experiences in this respect. This country had been working on the subject for nine years and still had only one type of high-power reactor operating—the air-cooled piles at Windscale. Construction of the two Calder Hall reactors was well advanced and work had started on the Dounreay fast breeder reactor. The total cost of undertaking the reactor programme had been much greater than the actual construction cost of the reactors themselves. Before the Calder reactors could be designed and constructed there had been a progressive series of steps.

If a project was to be restricted to natural uranium the reactor would probably have to be of the gas-cooled graphite-moderated type with the heavy water moderated type. Otherwise it was practically certain that enriched fuel would be required. But the construction of a diffusion plant to enrich uranium up to say 90 per cent U235 could hardly be constructed for less than £20-30 million and there was a possibility that the demand for U235 might not continue as regenerative reactors producing plutonium or U233 were developed.

Also the cost of feed-materials plant and a separation plant for treating the irradiated fuel had to be considered. It is concluded that any attempt to pursue simultaneously several lines of development through the prototype stages would need the resources of a project comparable with that in the United States.

Boiling-Water Reactor

Mr. W. H. Zinn (U.S.A.) presented a paper by himself and others on "Design and Operating Experience of a Prototype Boiling-Water Power Reactor." In this steam is generated directly in the reactor vessel constructed by the Argonne National Laboratory. The steam produced is vented to the atmosphere or delivered to a 3,500 kW turbo-generator.

Describing the construction Mr. Zinn said that easily and cheaply fabricated and re-processed elements were important. Aluminium was used for the heavily-loaded fuel elements and the uranium employed was enriched in U235 to about 90 per cent. The paper dealt in detail with the considerations which were taken into account in the reactor core assembly. This was carried on a framework supported in a stainless steel tank. Cadmium, boron and hafnium were the absorbing materials used for the control rods.

The plant had three principal flow circuits. The power circuit consisted of a feed-water pump which supplied condensate from the condenser or freshly de-ionized water from the make-up system. Next there was a pump and electric heaters which enabled the reactor vessel to be pressurized without operation of the reactor. The third circuit consisted of filters and ion exchange columns; as these became radioactive they were installed in the fuel element storage canal to obtain the necessary shielding from the water.

The authors said that it had been possible to operate the reactor under conditions which were stable for all pressures from atmospheric to 300 lb/sq in. Details of a number of experiments were given in the paper and there was an analysis of cost showing that with U235 at $15 per gram it was 30 mills/kWh, rising to 34·6 mills with U235 at $30. Almost half the cost was due to capital investment and operation cost; it was doubtful whether these could be improved very much. Of the fuel costs the major part was for fabrication and processing in which considerable improvement was possible.

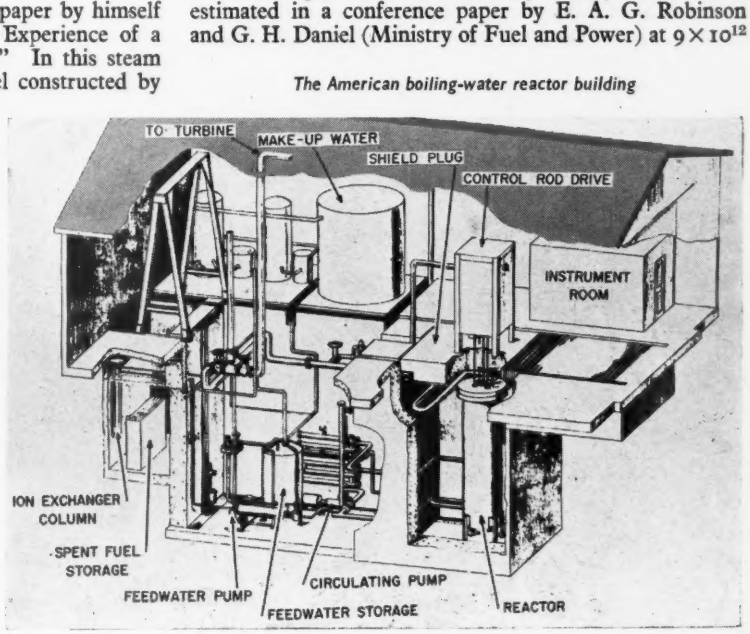
Expansion of Nuclear Power

Sir John Cockcroft (Atomic Energy Research Establishment) concerned himself mainly with future United Kingdom developments up to 1975. He said that output and efficiency of graphite-moderated reactors, as at present used, would be improved by raising pressure and temperature and improving heat transfer characteristics. Individual outputs of the twelve projected C.E.A. nuclear power stations—to be equipped by industrial organizations with technological help from the Atomic Energy Authority—were expected to increase progressively from 100 MW to at least 200 MW, giving by 1965 a total installed capacity in excess of 1,000 MW.

Experience thus gained would result in more rapid expansion, and by 1970 most of the new British stations would be nuclear. By 1975 the nuclear capacity would probably reach 10,000 to 15,000 MW, out of a total of 55,000 to 60,000 MW of the public electricity supply system, but as the nuclear power stations would run on base loads they would provide 40 per cent of the kWh, thus saving at least 40 million tons of coal yearly. Probably all energy in excess of 1975 requirements would come from nuclear sources, which by the year 2000 would be doing the work of 150 to 200 million tons of coal.

World requirements for electricity in the year 2000 were estimated in a conference paper by E. A. G. Robinson and G. H. Daniel (Ministry of Fuel and Power) at 9×10^{12}

The American boiling-water reactor building



kWh, equivalent to the burning of 3,500 million tons of coal, out of a total demand for primary fuel of 7,500 million tons. Having regard to available power resources, 2,000 to 3,000 million tons of coal would have to be replaced by nuclear energy.

The achievement of this aim, Sir John said, would depend upon the efficiency of utilization of fission energy, which was expected ultimately to reach 33 per cent, when one ton of nuclear fuel would do the work of one million tons of coal in a fast full-scale reactor such as that described to the conference by J. W. Kendall and T. M. Fry (A.E.A.).

The initial British graphite-moderated reactors had the advantage of being able to use natural uranium fuel and needed no enriched uranium from a diffusion plant. In a single fuel cycle with this type the extraction of 3,000 MW-days per ton of uranium was expected, equal to 10,000 tons of coal. The extraction limit was determined by the deterioration of fuel elements rather than by nuclear factors.

At the end of the first cycle the fuel elements would contain fission products, which would be removed chemically, and uranium and plutonium, which would be recycled. Alternatively the plutonium could be fed to later reactors requiring enriched fuel, e.g., water-moderated or sodium-graphite or fast breeder types. Repeated recycling was shown by Dr. J. V. Dunworth (A.E.R.E.) in another conference paper to reduce the concentration of U235 and to fission an appreciable amount of U238, thus possibly increasing the heat extraction rate to equal 100,000 tons of coal.

Power outputs, Sir John believed, were likely to rise to at least 150 MW per reactor and capital costs to fall to below £90/kW installed. As possible successors to graphite-moderated reactors, water-moderated designs showed promise.

Results obtained at Harwell with a zero-energy fast reactor (" Zephyr ") were shown in a paper by R. Shepherd (A.E.R.E.) to indicate that the amount of secondary plutonium bred from U238 should be substantially greater than that fissioned in the core, using up most of the U238 as well as U235. In view of such improvements in uranium utilization in two factors of ten, Sir John expected technological progress to be more rapid than expansion of demand for nuclear power, which in 1975 would be met by an annual consumption of not more than 400 tons of uranium together with initial requirements for new power stations, which might exceed that figure.

The possible need of the United Kingdom in the year 2000 for the equivalent of 250 million tons of coal could be met by burning 250 tons of uranium or thorium in breeding reactors. World electricity supplies by then would use between 2,000 and 3,000 tons of nuclear fuel plus initial amounts for new reactors. There should be little difficulty, as other papers showed, in securing enough uranium. A great deal of technological work remained to be done, but he had no doubt that the problems would be solved. The United Kingdom programme was flexible and would be subject to changes according to scientific progress made during the next ten years.

The B.E.P.O. pile at Harwell was described by R. F. Jackson (A.E.R.E.), who claimed that its simplicity of design and operation would ensure its continuance in experimental use for research and training and for providing isotope production facilities.

The Role of Thorium

Discussing the possible use of thorium, Dr. J. V. Dunworth (A.E.R.E.) stated that a homogeneous reactor might have a small gain factor not exceeding 10 per cent. In a heterogeneous reactor employing solid thorium containing U233 the gain factor might be negative by 5 per cent but the deficiency could be corrected by adding U235 or plutonium. Both metallurgically and chemically, a thorium-U233 system was preferable to a U238-Pu system, but present indications were that tens of tons of fissile material would have to be available. When that happened thorium would probably be a more valuable fuel even than uranium. Methods of decomposing monazite concentrates to obtain thorium of the requisite high purity were considered in detail in a paper by G. E. Kaplan (U.S.S.R.).

Under-Developed Countries' Needs

In a United Nations paper on nuclear power for underdeveloped countries (as indicated by low consumption of energy per head of population) especial attention was paid to the use of small reactors, often in competition with diesel units. Fuel costs per kWh would not substantially exceed those for large reactors and their higher capital costs per kW might in time be reduced through large-scale production of standard types. Where alternative sources of electricity were expensive owing to high costs of transmission or of imported fuel and/or its transport, a low plant load factor might not prove uneconomic. Appreciable savings in foreign exchange might accrue from the low fuel cost as compared with conventional methods.

Leaders of the British Delegation: (Left to right) Sir Edwin Plowden, Sir John Cockcroft, Dr. J. F. Loutit, Sir George Thomson and Sir Harold Hartley

Comparative Costs

Assuming a coal cost of £4/ton, nuclear power should be competitive almost immediately with normal thermal stations at annual load factors above 60 per cent, according to J. M. Kay (Kennedy & Donkin). It would seldom be a competitor of hydro schemes either of the large low-

head or the large storage variety. Smaller medium-head hydro installations with limited water storage could economically deal with peak loads in conjunction with base-load nuclear stations. Pumped storage would also provide a means for coping with peak loads.

The development of the boiling-water reactor would introduce flexibility by combining nuclear and combustion heat in a single thermal cycle. Graphite-moderated gas-cooled reactors, being inherently safe, could be placed near centres of consumption, but availability of cooling water would be the principal requirement of a site for a nuclear power station. Some of the more advanced homogeneous reactors might have to be at remote sites to facilitate effluent disposal.

Precautions Against Accidents

Safety aspects were discussed in detail by three American authors (Messrs. McCullough, Mills and Teller) in relation to the escape of radioactive fission products and damage to reactors through a "runaway." The former was the more dangerous and necessited making the building gas-tight. It need not be explosion-proof because nothing like an explosion would occur and the effects appeared not to be violent and would be less than those due to consequent chemical reactions. The safety of a reactor depended upon its intrinsic built-in stability and its reliability. The first condition was fulfilled when reactivity decreased rapidly with increasing temperature, as in some designs. Special problems arose in loading and unloading fuel and in starting up and shutting down the reactor.

A great need was for the development of a fuse, self-contained, wholly automatic and activated by changes in the power level, which would introduce a substantial negative reactivity within one second. Such a fuse seemed likely to be available shortly. Results of experimental runaways of a solid-fuel water-moderated reactor and a water-moderated homogeneous reactor were reported in a paper presented by J. R. Dietrich (Argonne National Laboratory, U.S.A.).

The Dounreay Reactor

In a paper on "The Dounreay Fast Reactor Project" J. W. Kendall and T. M. Fry explained that this was an experimental project with the aim of demonstrating the feasibility of generating industrial power with fast reactors. To allow for developments in core design, the plant was being made in the form of a shielded pot through which sufficient liquid sodium or sodium-potassium alloy could be pumped to extract 60 MW of heat. All the contents of the pot would be removable.

The supply of coolant must be reliable. The primary circuit would, therefore, be completed by twenty-four branches exchanging heat to independent secondary liquid-metal circuits. Each would incorporate an electro-magnetic pump. The primary circuit would be made from stainless steel for high temperature strength and to simplify circuit cleaning. It would be butt-welded with radiographic inspection throughout, following the techniques found satisfactory for the plutonium separation plant at Windscale. There would be no valves or glands below the free surface of liquid metal. The pumps would be grouped in pairs with independent electrical supplies to avoid the possibility of simultaneous failure. Each secondary circuit would be followed by a steam circuit and a sea-water cooled condenser. To avoid activation of the secondary coolant, the pot would be surrounded by a neutron shield and closed at the top by a thick plug, mechanically sealed during operation.

The heat exchangers would occupy an enclosure, maintained hot enough to keep the coolant molten, inside a concrete biological shield. This would consist of a bowl 90ft in diameter and 45ft in height. The concrete structure would support the pot, neutron shield and heat exchangers.

The reactor would be enclosed in a steel sphere to safeguard the district in the event of an accident which might release radioactivity. The sphere, which would be 135ft in diameter, had been designed for a maximum internal pressure of 17 lb/sq in and a maximum external pressure of 4 lb/sq in. These were considered to be the worst possible conditions to which it might be subjected. The possibility of an explosion due to run-away of the nuclear reaction could be ruled out in the design of the core and the control system. Water would be excluded from the sphere and the concrete would be jacketed to prevent contact with sodium. The remaining source of pressure rise might be the reaction of sodium with the air inside the sphere. This could only take place as fast as the sodium could be vaporized by the shut-down heat from the reactor. Heat transfer from the air to the pressure vessel would limit the pressure rise.

Graphite Moderation and Gas Cooling

"The Graphite-Moderated Gas-Cooled Pile and its Place in Power Production" formed the subject of a paper by Sir Christopher Hinton (managing director, Industrial Group, U.K. Atomic Energy Authority). The author said that although graphite-moderated water-cooled piles which were not inherently stable were built at Hanford for plutonium production, we in Great Britain did not follow suit because of the large safety distances involved. Instead we constructed two graphite-moderated air-cooled piles, which were inherently stable, to produce fissile material, having first decided that reasonably economic operation could be attained by flattening of the neutron flux across the core.

In the two piles at Windscale all the heat was wasted, but in the two graphite-moderated gas-cooled piles at nearby Calder Hall the heat of fission was used to raise steam which drove turbo-alternators for the production of electricity. The graphite moderator was contained in a cylindrical steel pressure vessel surrounded by a steel thermal shield and a concrete biological shield. The fuel elements were accommodated in vertical channels in the graphite while the charge and discharge arrangements along with the control and shut-off gear were situated on the pile vault roof.

The hot carbon-dioxide coolant from the pressure vessel was passed through four heat exchangers before being boosted by the compressors back to the pressure vessel. Steam was raised at two pressures in the heat exchangers which contained economizer, evaporator and superheater sections, and then it was led away to the generator houses to drive the turbo-alternators. These sets had a full load capacity of 23 MW each at 11 kV from which power was fed to the Central Electricity Authority's grid. A closed circuit water cooling system incorporating twin cooling towers was employed for the steam condensers.

The recent White Paper published by the British Government shows that when a reasonable allowance was made for the value of the plutonium by-product from the graphite-moderated gas-cooled piles, electric power could be generated for 0·6d/kWh. It should be possible to reduce that cost in future thermal reactor designs by progressing with larger and thicker pressure vessels or by finding more suitable coolants. The use of a slightly enriched uranium charge might also lead to economies while there was also scope for improved and cheaper designs in the pure engineering field.

The construction of the graphite-moderated gas-cooled reactor was the basis of the British programme for industrial power which in the decade until 1965 should realize a total nuclear power generating capacity of 1,400-1,800 MW.

It was useful to think of nuclear reactors in an ascending scale of the specific heat rating of their fuel elements and we in Britain were attacking the two ends of this scale. At one end lay the Calder Hall thermal reactor, the low-speed reciprocating engine of the reactor world, while at the other end lay the Dounreay fast reactor, the high-speed gas turbine of that world, but it would be a mistake to consider that the former had only a limited future.

Economics of Nuclear Power

One of two papers on the economics of nuclear power was by J. A. Lane (U.S.A.). In this the author surveyed the five-year programme being carried out by the U.S. Atomic Energy Commission. In this five types of reactors were contemplated, namely, the pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor and the aqueous homogeneous reactor (using a dilute solution of U233 in heavy water as the fuel).

The differences in the cost of power from the various types are due mainly to the variations in the amounts of fuel and fertile materials used and the cost of processing them. Present indications were that the net fuel costs of all these reactors, after crediting the new fissionable material produced, would be low enough to make their output competitive with coal-produced electricity.

These prototype reactors would provide information leading to reduced costs and permit a more realistic evaluation of the application of nuclear energy for larger-scale power production. Five full-scale reactors were to be built by private industrial groups. This was more venturesome but in most cases the estimated power costs were more strongly affected by the various non-technical assumptions employed, such as plant write-off, inventory charges and load factor, rather than technological considerations.

The author thought that these non-technical assumptions reflected the degree of optimism or pessimism of those making them but the optimists predominated and the outlook seemed very encouraging.

A review of the many published estimates of the cost of producing nuclear power led the author to conclude that there was a good possibility that power costs within the range of 4 to 7 mills (0·34d to 0·59d) per kWh would be realized within the next fifteen or twenty years. Nuclear plants would then compete for an appreciable fraction of all new plants built by 1975.

J. A. Jukes (United Kingdom) followed with a paper on " The Cost of Power and the Value of Plutonium from Early Nuclear Power Stations." He first stated some of the technical and economic factors—the capital cost and the life of the reactor and generating plant; fuel processing costs; heat rating per kg of fissile material; the fraction of material consumed before processing became necessary; conversion factor, i.e., the fissile material produced per unit consumed; thermal efficiency of the generating plant; interest rate and overhead operating expenses; plant load factor; insurance premium; and, finally, the prices of uranium and plutonium.

The author then went on to give in more detail the basis of the estimates contained in the White Paper " A Programme of Nuclear Power." He said that the Calder Hall station, now approaching completion, was expected to cost about £16½ million of which nearly £7 million was the cost of the two reactors which would have an output of over 50 MW. As the station was not designed purely as a power producer it was not given the maximum power output which it could have had. Known modifications of the design could increase the electrical output by 50 per cent without a significant increase in the capital cost. Moreover experience gained in developing the Calder Hall station had indicated minor improvements which should easily enable double this higher output to be obtained. It was not impossible to envisage that the stations on which design work was starting would have an output in the region of 200 MW, but he would cautiously assume only 150 MW.

On that basis the author produced cost estimates of a total capital and overhead cost of £23·8 million, including reactor items £7·5 million, other plant £11·3 million, and cost of initial fuel at £20,000/tonne U £5·0 million. The annual capital charges were put at £1·57 million and the total gross annual costs at £3·33. With an 80 per cent load factor (base-load operation) the total gross cost per kWh was estimated at 0·76d (or 9 mills). The annual cost for the reactor was conservatively based on a 15 years' life and that for the rest of the plant on the normal expected life. Mr. Jukes explained the basis of his operating costs and said that the gross cost allowed no credit for the sale or use of the plutonium produced. A new high load factor coal-fired station could produce electricity at 0·60/kWh.

If the early nuclear stations were unable to sell their plutonium it would be extracted, made up into suitable fuel elements and fed back into the reactor, reducing the amount of natural uranium required. Various technical factors complicated the calculations but a reasonable guess at those factors would lead to a net cost of about 0·65d/kWh—not greatly in excess of the cost of power from conventional stations.

Although the present market for plutonium was artificial an attempt should be made to assess its value in a free market over the period of the life of a particular reactor. The possible uses of the material were surveyed and acceptable costs for each application were suggested, ranging from £3 to £12 per gram.

There was an inter-relation between the price of plutonium and that of uranium which would have an effect. It was considered that there would be a big unsatisfied demand for plutonium for civil purposes. Admitting that his calculations were " crystal gazing " Mr. Jukes suggested that it would be reasonable to expect a price for plutonium in the region of £12 per gram. Taking account of extraction costs there might be a net credit of from £5 to £10 per gram, amounting to 0·17d/kWh at £5 and 0·33d/kWh at £10 and reducing the net cost per kWh of electricity to 0·59d or 0·42d respectively (against 0·60d/kWh for power from a new coal-fired station).

Professor Niels Bohr, the eminent Danish physicist, gave the first of a series of evening lectures. He was introduced by the President (Dr. Bhabha) who paid a tribute to Professor Bohr's fundamental work and mentioned that he would be seventy in October. Professor Bohr took as his subject " Physical Science and Man's Position " introducing it with a reminder of the discoveries of Rutherford and Enrico Fermi and the philosophy of Einstein who, he said, had widened the horizon of mankind. The last of the series is to be given by Sir John Cockcroft.

NATIONAL DISPLAYS

Several countries have arranged displays of their work especially for the delegates to the International Conference on the Peaceful Uses of Atomic Energy. These have been arranged within the Palais des Nations and in the extensive grounds of the palace. The principal exhibitions are those of the United States, the United Kingdom, Canada and the Union of Soviet Socialist Republics.

Sir John Cockcroft was present at the opening of the British section, arranged by the United Kingdom Atomic Energy Authority, in which much prominence is given to this country's ten-year programme of atomic power development. Full explanations are given, in four languages, of the construction and methods of operation of the first of the two Calder Hall graphite-moderated pressurized gas-cooled piles, and they are illustrated by photographs, diagrams and models of the No. 1 reactor and turbine hall.

The fast fission breeder reactor on which work has started at Dounreay in the North of Scotland is also given attention. In this liquid metal cooling is to be employed and, apart from producing more "fuel" than it consumes, it will supply a useful amount of power for public supply. A model is shown of the high-flux research reactor E.443 ("DIDO") which when it is completed by next summer will have the highest neutron flux in Western Europe. It is a heavy-water cooled and moderated reactor using an alloy of enriched uranium and aluminium as fuel. Among the purposes for which it will be used are the study of the effects of radiation on materials, including the behaviour of reactor fuel elements; the production of high activity radioisotopes; and experiments upon small pilot fuel and coolant systems.

The whole equipment is heavily protected and will be contained in a large steel dome. There will be sixty experimental openings in the biological shield. The maximum thermal flux will be 10^{14} neutrons per sq cm per second; the total heat output 10 MW; the heavy-water "investment" 10 tons; the U235 investment 2·5 kg; and the total power consumption, including instruments and experiments, 1,200 kVA.

Other reactors dealt with in the exhibit are RE775 ("PLUTO") two of which are being constructed on the same basic design as "DIDO" for testing purposes; "DIMPLE," a zero-energy heavy-water moderated reactor for fundamental reactor physics research; "ZEPHYR," in which a core of plutonium is surrounded by an envelope of natural uranium (about 8 tons); and "ZEUS," a full-scale zero-energy version of the Dounreay reactor to be used for the study of neutron characteristics, critical conditions and control calibrations.

Other exhibits are spiral aluminium and magnesium finned sheaths for fuel elements; examples of graphite machining; demonstration of fuel reprocessing methods; special instrumentation; and samples of typical uranium-bearing minerals.

United States' Exhibits

Models of several types of reactor are included in the United States' indoor display, including a materials testing reactor, the Argonne research reactor and the boiling reactor power plant, as well as diagrammatic explanations of other projects. Attention is paid to the production of uranium and thorium and to the fabrication of other reactor materials. Many examples of instruments are shown and the applications of irradiated materials and radioisotopes are illustrated.

A large wooden building has been erected in the grounds in which the U.S. Atomic Energy Commission has installed a "pool" research reactor contained in a tank 10ft in diameter and 23ft deep. The immersed core of this is completely visible in the water; it consists of 23 elements containing about 3·6 kg of enriched U235. At intervals it is operated from an elaborate control room nearby when it gives off the blue glow known as the "Cerenkov effect." The Swiss Government is purchasing the reactor for the Federal Institute of Technology in Zurich. Other exhibits in the building are devoted to the explanation of the operation and purposes of the reactor for research and the production of radioisotopes.

Also in the grounds is a mobile radiological unit belonging to the U.S. Atomic Energy Commission. This contains a great deal of equipment for testing air and human beings for radiation in and around atomic energy establishments.

Canada has an excellent display in which one of the principal items is a model of the NRX reactor at Chalk River, about 130 miles from Ottawa, erected by Atomic Energy of Canada, Ltd., a Government-owned company. A large tableau in the centre of the exhibits depicts the use of beam therapy units and other items illustrate a number of "peaceful uses" of nuclear energy.

Much of the interest of the delegates is being attracted to the Russian collection. The centrepiece is a one-fortieth scale model of the atomic power station of the Russian Academy of Sciences and there is also a model of a heavy-water moderated experimental reactor now in use. Photographs are displayed of the 5,000 kW graphite-moderated water-cooled reactor power plant which is said to have been put into public service in June last year. Most of the space in the hall is occupied by photographs of radioisotopes and radiation applications, particular stress being laid on the medical side.

Many examples of instruments and apparatus are shown, the workmanship and finish being of a reasonably high standard and there is an excellent mineralogical display.

A combined exhibit by Denmark, Norway and Sweden includes models of the Norwegian Kjeller heavy-water reactor and a 300 kW helium cooled reactor constructed by the Swedish A.B. Atomenergi. Another feature is a "neutron chopper" built for the Dutch-Norwegian Joint Establishment for Nuclear Energy Research at Bergen. This is a shutter which admits bursts of a collimated beam of neutrons from a reactor; it is used for measuring neutron transmission of various elements as a function of neutron energy in conjunction with a time-of-flight system.

Belgium has a small display consisting largely of photographs.

Models and diagrams illustrating the research and development carried out by the Commissariat a l'Energie Atomique are the main features of the French collection. One of the models is of a proton-synchrotron being built for the Saclay research centre and there are illustrations showing the production of moderating materials for reactors—heavy water, graphite, beryllium, etc.

An explanation of the French reactor programme refers to the building of three piles at Marcoule by 1956-58 using natural uranium and heavy water for producing power and plutonium and the Saclay E.L.3 reactor, a prototype fast breeder reactor to be completed in 1957. The rest of the exhibits deal with protection methods, radioactive ores, electronic equipment and radioisotopes and their uses. The C.E.A., it is said, will have funds totalling $285 million at its disposal within the next three years.

NUCLEAR ENERGY EXPLAINED

Coinciding with the International Conference at Geneva on the Peaceful Uses of Atomic Energy, a popular illustrated booklet, "Nuclear Energy and its Uses in Peace," has been published by H.M. Stationery Office for UNESCO, price 2s 6d. Mr. Gerald Wendt is the author of the booklet and the Director-General of Unesco introduces the publication.

Opening with an elementary discussion on energy and fuels, the booklet, well and clearly illustrated with charts, line drawings and photographs, introduces the non-scientific reader in clear and simple language to nuclear fission and its vast implications for the future.

Engineering in Europe

Abstracts from Foreign Technical Journals

THE sometimes heated discussions about the relative merits of long distance d.c. and a.c. transmission often do not take into account the great ease of the supply of industrial and agricultural regions situated along an a.c. transmission line. It is clear that where such a supply is required, the layout of the transmission line must be different from that of a straight-through transmission line, and above all requires the insertion of an appropriate number of intermediate substations with special equipment. Particularly important is the role of synchronous compensators on such substations since they are not only required for maintaining the stability of the transmission, but are also capable of substantially contributing to an increase of the transmitting capacity of the line. The latter, however, is conditional upon the use of modern systems of excitation and on the compensation of the inductive reactance of the synchronous compensators by static capacitors.

The use of synchronous compensators compensated by capacitances is particularly rational in very long transmission lines, since the required rating of the synchronous compensators rises more slowly with increasing transmission distance than the rating of the static capacitors required for series compensation. An added advantage is the possibility of reducing the rotor current in normal operating condition and obtaining increased forcing effect. The self-excitation of such compensators is prevented by the insertion of active resistance into the stator circuit or by a special construction of the synchronous compensators.

The conditions of self-excitation may be determined by Gorev-Park's equations which are 7th and 9th order equations and in their most general form consider electromagnetic processes as well as small rotor oscillations. An analysis based on these equations enables the conditions of prevention of self-excitation to be established and also gives valuable indications for design of the synchronous compensator and for the best method of regulating the excitation to be obtained.—" Long Power Transmissions with Intermediate Synchronous Compensator," D. I. Azariev, N. N. Sokolov and V. A. Venikov, *Elektrichestvo*, No. 4, pp. 11-16, 1955, in Russian.

Tracking on Plastics

The formation of tracking paths on plastic insulating materials is closely associated with the thermal decomposition of these materials which may be initiated by the Joule's heat of tracking currents or of discharges. In thermosetting plastics and some of the thermoplastic materials a progressive carbonization takes place when the temperature rises. The quantity of the residue at higher temperatures depends mainly on the character of the original material, but not the electrical conductivity. The latter drops gradually from about 400 deg C and reaches at about 800 deg C the value of ground graphite. Plastics leaving an appreciable residue above this temperature have a negligible resistance to tracking (phenolic plastics). In general, however, the residue will be too small for tracking paths to be formed. Temperatures of about 500 deg C are, on the other hand, dangerous for many types of plastics (including aminoplastics) because the conductivity as well as the amount of residues are high enough to allow tracking path formation. Yet these temperatures are rarely reached in electrical installations except where discharges take place.

Many thermoplastics are decomposed into volatile fractions and therefore cannot form tracking paths. Plastics with inorganic plasticizers and silicones may be affected by tracking path formation if the inorganic component leaves a residue rich in carbon. If the decomposition yields a sufficiency of volatile carbon compounds (phenolic plastics and some thermoplastics) soot production may occur if the gaseous products of decomposition have to pass through an electric arc. Soot deposits may obviously form conducting bridges. The tracking-safety of a plastic material therefore depends essentially on the chemical composition of its structural unit. The suitability of any test method will be determined by the method of thermal stressing used in it, and by other factors.—" Formation of Tracking Paths on Plastics," K. Schumacher, *E.T.Z.(A)*, Vol. 76, No. 11, pp. 369-376, 1st June, 1955, in German.

Contact Metals

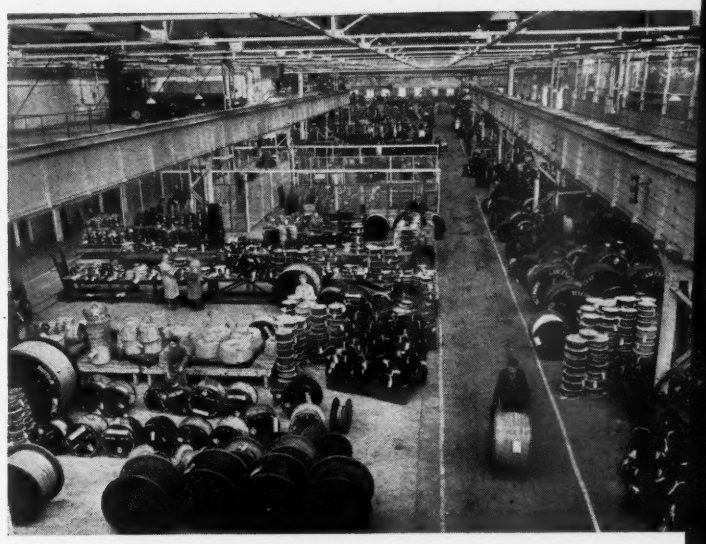
Comprehensive investigations into the performance of contact metals, above all of precious and rare metals, in relay contacts yielded the result that hardly any of the theories of contact phenomena so far advanced may be taken as generally valid nor any series of experimental results published as truly representative of the performance of the materials tested under all possible conditions. The series of tests carried through by the author was intended to elucidate many doubtful points in previous publications, which did not square with service experience. The tests dealt with contact wear under switching operations with contacts carrying current, and also without current load, so as to separate mechanical from electrical wear phenomena. Also, the contacts were tested with artificially produced sparks. The chemical composition and metallurgical structure of the contacts are obviously very important in determining the wear characteristics.

Softening and melting temperatures of the contact materials, whether elements or alloys, electrical and thermal conductivities, and the temperature coefficient of the resistivity, all play their part in the specific wear mechanism of any contact material, apart from the unavoidable physico-chemical reactions such as oxidation and reduction processes continuously altering the original characteristics of the contact material during sustained service. And yet some general conclusions could be drawn on the lasting characteristics of various materials and combinations, especially which combinations of contact materials have hardly any tendency towards transfer of material and bridge formation, and which do not oxidize appreciably, all this improving the wear characteristics considerably.—" Contact Metals and Relay Contacts; Characteristics and Comparative Investigations," Th. Gerber, *Tech. Mitt. PTT*, Vol. 33, No. 3, pp. 89-114, 1st March, 1955, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates. — Editors, *Electrical Review*.

Plastic Cable Manufacture

BICC CONCENTRATES ITS PRODUCTION AT HELSBY



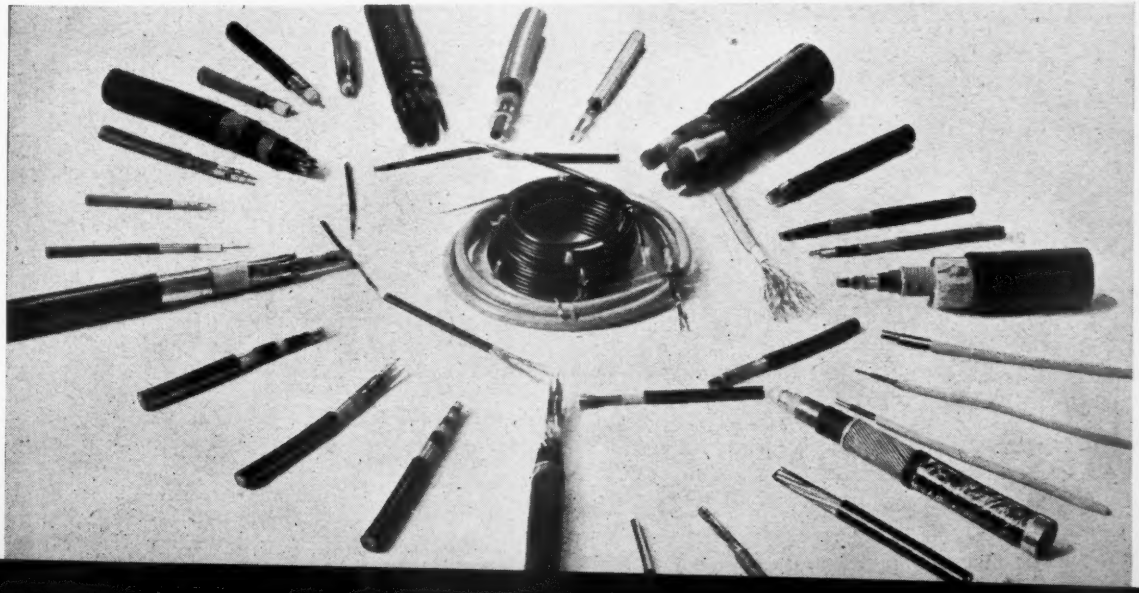
IN recent years plastic materials have found increasing application as insulating media for electric cables of all types, for both low and high frequencies. Although they were extensively developed as substitute materials during the wartime rubber shortage, plastics have subsequently proved themselves particularly suitable in the high frequency range and where non-inflammability is desirable. It was with interest therefore that we made a recent visit to the Helsby factory of British Insulated Callender's Cables, Ltd., where the company's plastic cable manufacture is centred, producing what must be the largest quantity and the widest range of such cables in this country. The company has been making plastic cables for many years now but during the past two years plastic cable production has been concentrated at Helsby, where the factory, together with its extensive cable making plant has full facilities for mixing and compounding p.v.c. and polythene. An unusual if not unique line among British cable makers is followed by BICC in that they do not purchase all their plastic materials in a fully compounded state.

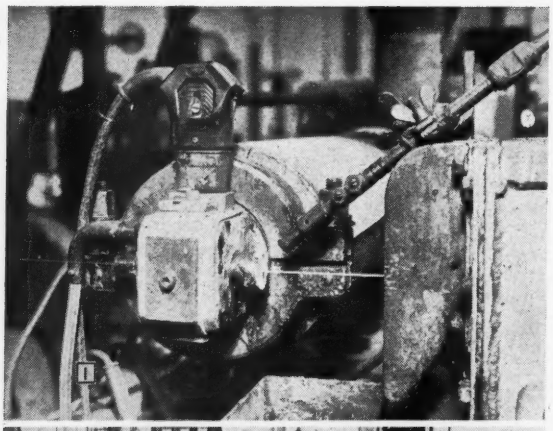
Apart from the main production unit itself there is a new laboratory housing the technical department which exercises all development and engineering functions. Here, chemical, compounding and electrical laboratories are operating and a pilot plant has nearly been fully equipped. Test equipment of the most modern type is being used in assessing the mechanical and electrical qualities of new materials and improved types of cables.

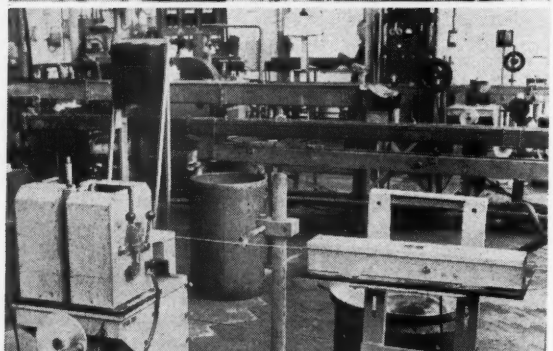
It is probably true to say that thermoplastic materials are suitable for a wider range of applications than any earlier cable making materials, and this fact is exemplified by the wide variety of types in manufacture at Helsby. It would be impossible to list the complete range but mention can be made of a few.

House wiring cables with plastic insulation are now well established and are made in large quantities. P.v.c. will not propagate flame and is moisture- and oil-resistant, and these qualities are valuable in these cables and in many others for industrial use. Increasing use is being made of p.v.c. insulated, steel wire armoured and p.v.c. sheathed cables in collieries, etc., and these cables can be buried direct in the ground. The resistance of p.v.c. to fungus and microbiological attack generally makes it especially suitable for use in tropical conditions, and also as a protection over the armour of conventional lead-sheathed cables. Telephone exchange equipment is using increasing quantities of p.v.c. insulated wire and cables where the good ageing properties of the plastic material and the ability to obtain thin coatings (0·009in radial for example) in a wide range of clear colours are important features.

A selection from the range of BICC plastic cables







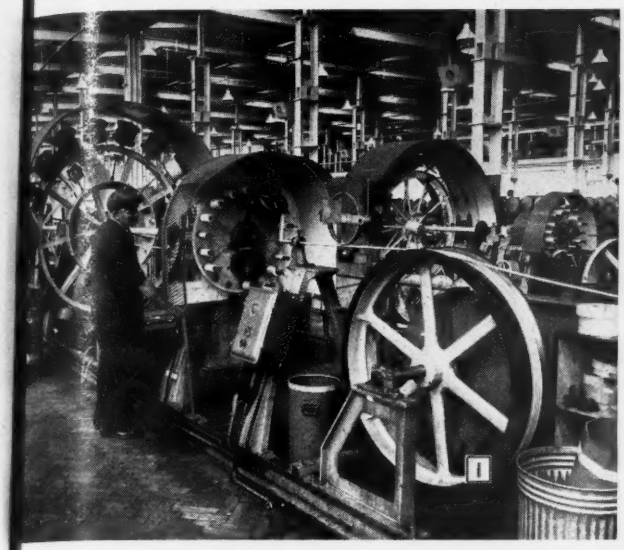
Polythene is the high frequency dielectric *par excellence*, and many cables made at Helsby employ it. Even at audio frequencies it has advantages in special cases, as for example in the distribution cable used by the Post Office in subscribers' networks. Here the low water permeability of polythene justifies its use in the cable sheath and it is in fact frequently installed by direct burial in the ground. Even if the sheath suffered mechanical damage and the cable became full of water the polythene insulation would still enable the cable to function. Polythene, with its very low power factor and permittivity, finds increasing advantage as the operating frequency is raised, and it is used as the insulation in television camera cables. The company supplies cables complete with couplers to all the British camera manufacturers, and BICC cable was used with underwater cameras at the scene of the Affray and Comet disasters.

Other uses of plastic cables in television include quad cables for wired television distribution. More will be said about these cables later, but it can properly be noted that their realization in practical form depends entirely on the use of plastics and particularly polythene.

For radio frequency cables polythene insulation and either a p.v.c. or polythene sheath are customary. These cables were highly important in the wartime development of radar, and in peacetime the use of similar cables as aerial downleads has matched the expansion of the television industry. Cellular polythene, a new dielectric material, is finding its first application in this field, but is clearly destined for much wider exploitation.

The first stage in the production of plastic cables is the processing of the raw materials, such as polymers and plasticizers. The p.v.c. is prepared at Helsby by mixing the polymer with the plasticizer, etc., in a Banbury internal mixer. After mixing it is cooled and then diced, i.e., cut into small chips of about $\frac{1}{8}$in cube. The diced material is then fed into the hopper of the extrusion machine. This consists essentially of an electrically heated barrel containing a scroll or worm which transfers the softening p.v.c. compound to the head which is set at right angles to the scroll. A thermostatic control system is arranged to ensure a close control of the temperature of the softening p.v.c. compound. Accurate control here is vitally necessary since different temperatures obtain at different parts of the machine: if the temperature at the extrusion head is too high the material will char and if it is too low it will be rough in appearance.

(1) Extruding polythene insulant on to a 0·0245in conductor core for Post Office distribution cables. (2) Eccentricity gauge measuring and sensing head with pulse injection unit on the right. (3) Caterpillar type take-off equipment is used when it is undesirable to bend the cable. (4) These machines apply copper braiding to cellular polythene insulated television downlead cables



(1) *Laying up a Post Office distribution cable.* (2) *Display unit of continuous reading eccentricity gauge.* (3) *Capstan type take-off equipment*

The extrusion heads of the machines have been designed to give consistent flow and temperature around the periphery of the conductors. The wire to be covered is fed into the back of the extrusion head and passes through its centre core tube. The softening p.v.c. flows around this core and through a die to form a tube of insulating material around the conductor. The relative positions of the die and the centre core can be varied depending upon whether it is required to fill or leave open the interstices between strands or laid up cores. The tightness of fit of the insulating coating on a single wire can be varied in the same way.

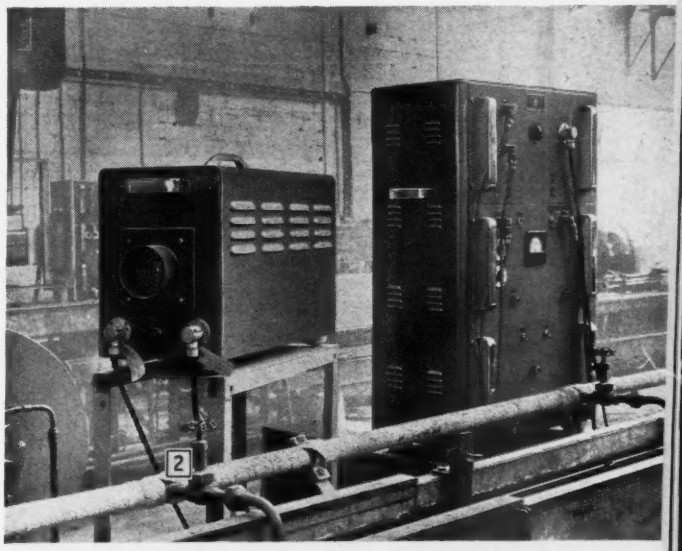
After leaving the head of the extruder the insulating material coating is immediately cooled in a water trough. The amount of cooling necessary varies with the diameter and speed of travel of the cable through the machine and also with the thickness of the plastic coating being applied. From the trough the coated cable passes through an eccentricity gauge, diameter gauge, spark tester, round haul-off equipment either of the capstan variety or the caterpillar type, and then on to the take up drum.

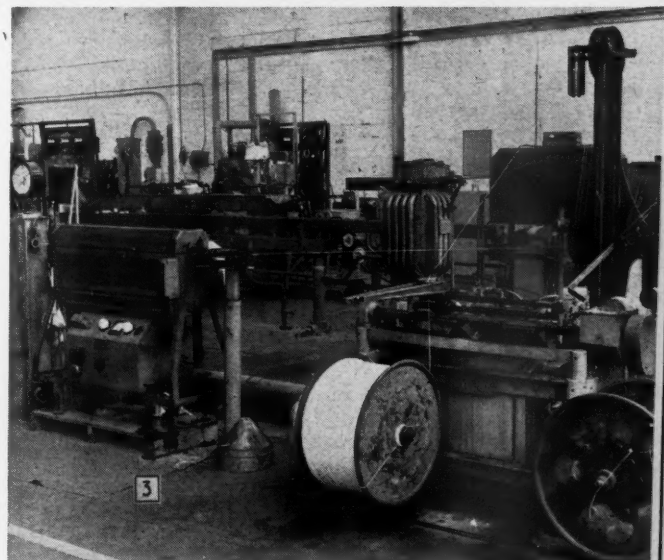
Polythene extrusion is carried out in exactly the same way but the material is received into the works in diced or chipped form ready to be put straight into the hopper of the extruder. Extrusion temperatures are also different and in some cases graded cooling arrangements are necessary but generally speaking the process is very similar to that for p.v.c. extrusion. After it leaves the extrusion machine the covered wire or cable is overhauled, i.e., it is visually inspected and spark tested. All completed cables and component parts of certain types of cables are then passed to the electrical testing department where they undergo tests in accordance with the relevant specifications. Special tests carried out in this department include pulse testing of television relay cables. High voltage tests, cross-talk, impedance, continuity and insulation resistance tests are all carried out in this department to ensure a high standard of reliability of the final product. After testing all completed cable is transferred to the warehouse where it is packed ready for dispatch.

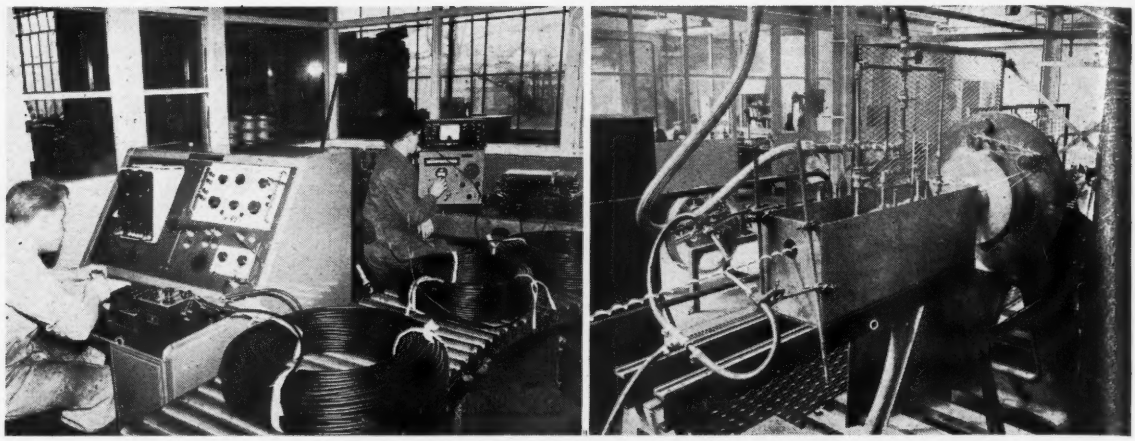
Uncompleted cable or core is passed to its next process. For example, in the case of a multi-core cable it would go to the laying up and stranding department for assembly with other cores for the same cable. If need be it would then go back to the extrusion department for a further outer covering.

In view of the unusually wide diversity of cables which are produced in this factory it is not possible to see a single clearly defined production flow line. Instead, depending upon the cable involved, the component parts flow back and forth between the laying up, stranding and bunching, braiding, armouring and the extrusion departments, at each stage additional cores or coverings being applied until the completed cable or wire is ready for its final testing.

Normally single colours are adequate for cable core identification purposes as a very wide range of different colours are available with plastic materials. However, in certain instances such as for multi-core telephone cables, it is necessary to apply striped coverings to the wires and a great variety of colour combinations can be obtained. There are several ways of achieving this striped covering. In the BICC process the conductor wire is first covered







Left: Pulse and crosstalk testing television relay quads. Right: Pilot machine for making helical polythene insulated coaxial cable

in the normal way with a p.v.c. coating in the base colour required. It is then passed through a machine which applies a p.v.c. ink stripe around the base coloured wire. The stripe is then bonded to the base by heat treatment so that it does in fact become an integral part of the insulation.

As mentioned previously, the technical department is concerned with cable development, design and test (the latter including tests on cable materials). Geographically, the development, design and materials test functions are concentrated in the cables laboratory, a 20,000 sq ft building the interior of which has recently been completely rebuilt. Cable test is located, again in modernized accommodation, adjacent to the main production shop. Steel and glass partitions have been widely used in the laboratory and test house to give a light and spacious effect, and in each case allowance has been made for future expansion.

The cables laboratory building houses the pilot plant, electrical, chemical and compounding laboratories, and cable design engineers. The pilot shop is 165ft long by 60ft wide and is already partially equipped with its machines, some under development and some standard. The latter include two 42in plastic mills, and a 2in extruder is currently being installed. A second extruder is projected, and it will soon be possible to carry forward development work on a broad front without interfering in any way with factory production. It has been recognized that production and development efficiency will together best be served by very adequate plant and space provision in the pilot shop.

Running down each side of the pilot shop are ranges of steel and glass partitioned rooms which house a small model shop, drawing office, ultra-violet lamps, dark room, refrigerator, ovens and humidity cabinet, as well as office accommodation for the cable development engineers. Materials testing laboratories also open off the pilot shop.

The development of new or improved cables very frequently depends on the exploitation of new materials, and hence the chemical and compounding laboratories which concentrate on the formulation and evaluation of thermoplastic compounds assume prime importance. The two laboratories are sited together and are under the control of the chief chemist. The compounding laboratory is equipped with small mills and mixers, presses and a 2in extruder used for trial runs on experimental compounds.

Plastic cables find use throughout the frequency spectrum from d.c. to microwave frequencies, and the electrical laboratory must accordingly be equipped with measuring apparatus spanning the entire range. The apparatus includes conventional test gear for use at the lower frequencies as well as special radio frequency equipment such as a pair of high-precision slotted lines for impedance and attenuation measurements on cables at v.h.f. and microwave frequencies. These measuring lines have been designed and built within the company.

Among recent cable developments several can be selected for comment. Cellular polythene cables are probably among the most significant as far as future trends are concerned. Low permittivity coupled with low dielectric loss and adequate mechanical strength have always been the cable engineer's aims, and cellular or expanded polythene opens up new possibilities in these directions.

BICC was the first British firm to put cellular polythene cables on the market and since August, 1954, large quantities of television downlead coaxial cable have been manufactured, the majority with the company's own compound. Its density (in its present form) is about 0·45-0·50 and permittivity 1·4-1·5. Power factor at present is somewhat higher than that of solid polythene, and dielectric strength lower (as would be expected). However, for a great number of applications the last two factors would not be significant. The cellular pore structure is not interconnecting, and the water permeability thus remains low. There are still problems to be met in the close control of extrusion of cellular polythene and in attaining still more desirable properties but it already gives promise of a most important future in plastic cables.

The relaying of television signals by cable is now firmly established in many localities, but the permissible distortion of the signal in transmission is so slight as to impose stringent limits on the screened-quad cable manufacture. Moreover, the cable test programme is onerous. These two problems were each successfully overcome with the assistance of special electronic equipment developed by the BICC Telecommunications Laboratory at Kirkby. Firstly, the eccentricity meter was developed as an aid to the production of high quality extruded cable core. The device is in three principal parts, the measuring head, main electronic unit and display unit. The main electronic unit has an oscillator whose output is coupled to the wire running through the extruder. The measuring head then picks up and transmits signals back to the main unit. These signals, on passing through appropriate circuits, deflect the spot on the display unit cathode-ray tube to indicate the position of the conductor within the insulation. An effective magnification of several hundred is available, which enables any necessary extruder adjustment to be carried out precisely, without stopping the machine.

The second problem in developing television relay quad cables, that of volume of testing, was substantially eased by the development at Kirkby of a quad pulse tester. Pulse testing has been employed on trunk coaxial cables for some time, and by suitable adaptation of technique the necessary balanced circuits were provided. Two of these pulse testers are now in use in the factory, giving information on impedance level and impedance irregularities much more rapidly than would conventional bridge techniques.

The form of coaxial cable in which the inner conductor is supported by a helical web of insulating material has been well known for some years, and its merits have been widely recognized. BICC have developed their own technique for applying the insulation with the precision necessary to give a high performance cable for use at any frequency up to the microwave band. Again, low permittivity leading to very low attenuation is the aim, and cables in pilot scale production at Helsby have permittivity between 1·08 and 1·10 (dependent on type), whilst retaining very good mechanical support for the inner conductor. A died-down aluminium sheath is subsequently applied to the cable core.

In all their work, whether it is of a routine nature or on the development side, the technical department can draw upon the resources of the company's research organization, which has its main laboratories at Wood Lane, London.

Argentine Electrification Schemes

From a Correspondent

THE Transandine Railway, operating between Argentina and Chile, is to be electrified at a cost of 71 million pesos of which 40 million pesos will be spent on electric locomotives and rolling stock. The Argentine system is being adopted in preference to that of Chile, which would nearly double the cost. Power will be supplied from hydro-electric plant operated by mountain torrents in the Andes. When work on the Transandine Railway is completed electrification is to be extended to the Buenos Aires-Rosario line, the Cordoba Hills system, the Tucuman suburban lines and from Tucuman to La Quiaca, on the Bolivian frontier.

The Argentine Minister of Transport has outlined a plan to improve the Buenos Aires urban and suburban railways, including electrification of certain suburban lines and extension of existing electrical services. The plan will be financed by the sale of land that will become available as a result of the abandonment of certain tracks, goods depots and marshalling yards within the city and suburban boundaries.

The Ministry of Transport has ordered 55 electric railway coaches from the Kawasaki Rolling Stock Co., of Kobe, and the Kinki Rolling Stock Co., of Osaka, for the Sarmiento Railway (ex Western). The vehicles, all motor coaches of the single class type, will cost 40·9 million pesos, inclusive of spare parts.

Twenty-two firms from various countries, including Great Britain, submitted tenders for the San Nicolas thermal power plant/Greater Buenos Aires network interconnection (see *Electrical Review*, 22nd April, 1955). High voltage lines will carry power to a terminal substation near Moron and electricity will be distributed via substations at Vicente Lopez, San Andres, Villa Sarmiento and La Tablada. These will be connected by 132 kV underground cables, forming a ring round the city of Buenos Aires.

Power Problems

President Peron referred to the country's power problem in a recent speech to a parliamentary group. Hydro-electric plants, he said, could only be regarded as a local, or short-term, solution in Argentina. Consumption is practically confined to a line from Cordoba, through Rosario, to Buenos Aires, whereas the only sources of hydraulic power were in the Andes; 25 to 50 per cent of the power would be lost in transmission over the distance of 1,000 km and only 50 per cent of capacity could be relied upon owing to seasonal variations in the volume of water. The schemes for harnessing the Salto Grande and Apipo rapids would not be completed in less than fifteen years, but the power problem was urgent and would have to be solved by burning oil. After explaining the arrangements with the oil companies, who had undertaken to produce 20 million cu m within five years, against the present 4 million cu m, President Peron said he had also obtained from the electricity companies their agreement to make the necessary investments for burning the oil.

The new Anglo-Argentine agreement lists the following imports from the United Kingdom:—Radio, electrical and telecommunications materials, excluding wire and cables, £500,000; raw materials for the manufacture of dry batteries, £50,000; lamp accessories, £20,000; materials for manufacture of electronic valves, £50,000; special electronic and communications apparatus, £110,000; meters, £30,000. The Central Bank's import programme for 1955 allots a preliminary sum of 565 million pesos to Government agencies for materials for electricity services, metals and chemical products. Applications are invited for the importing of materials for electricity supply and radio and telephone communications, excluding wires and cables, against payment at free market rates.

A.S.E.E. Awards

The Association of Supervising Electrical Engineers has announced the result of the 26th annual competition for the W. E. Highfield Shield. The examining board, the members of which are Mr. Bryan Donkin, president of the Association, Mr. C. T. Melling, immediate past-president, Mr. R. F. Mathieson, national chairman, and Mr. J. H. K. Pendry, Technical Committee chairman, has awarded the Shield and prizes jointly to Mr. G. V. McNeill, of Forest Hill, London, for his paper entitled "The Servicing of Fluorescent Lighting Fittings" and to Mr. D. H. Taylor, of New Barking, Essex, for his paper entitled "Ultrasonics in Industry." Mr. Taylor and Mr. McNeill will each hold the Shield for six months and each will receive a cheque for £9 9s. The awards will be made to them by Mr. Donkin at the opening meeting of the Association's London national lecture session which commences at the Institution of Electrical Engineers, on 18th October.

The 9th examination under the diploma scheme of the Association was held in London on 25th May and the following candidates were successful:—Swann Diploma in Electrical Installations Practice: Messrs. A. E. Allcock (Brompton, Kent), W. R. Gardner (Haverhill, Suffolk) and A. A. Lewis (Beddington, Surrey). A.S.E.E. Technicians Certificate in Electrical Installation Work: Mr. N. B. Heaton (Atherton, Lancs). The award of the Technicians Certificate is made as a result of recent extensions to the diploma scheme and this year is the first in which the examinations for this certificate have been held. An announcement in respect of the 1956 examinations will be made next November.

INDUSTRIAL NEWS

Engineering Workers' Demands

Another claim for a substantial increase in wages was decided upon at the annual conference of the Confederation of Shipbuilding and Engineering Unions last week. It is believed that an addition of 10 per cent to the basic rate of skilled workers is the aim. The claim was to be formulated at a meeting of the Confederation's executive committee yesterday (Thursday) for submission to the Employers' Federation in the autumn. About three million employees in the engineering and shipbuilding industries are involved.

The conference also passed resolutions calling for a shorter working week, without a reduction in wages, the reduction of overtime, and three weeks' annual holiday with pay (instead of the present fortnight) with holiday payments related to average earnings instead of the basic rates.

Plumber Jointers' Allowances

The Standing Joint Committee of the Joint Industrial Council for the Electrical Cable Making Industry has agreed that the following amendments shall be made to the agreement on rates of pay and working conditions of plumber jointers and plumber jointers' mates, with effect from the beginning of the first full pay period following 14th August:—Clause 5, out allowance: The amount of the out allowance to be raised from 7s per day to 9s per day. Clause 10, travelling privileges: Free rail travel to be available six times a year instead of five times a year.

Electrical Equipment for Kenya

An important contract for electrical plant at Juja Road substation, Kenya, has been awarded to the British Thomson-Houston Co., Ltd. This substation has been specially designed in conjunction with the B.T.H. hydro-electric plant for Owen Falls generating station of the Uganda Electricity Board, and will transmit 40 MW of power to the Nairobi area of Kenya. The distance from Owen Falls to Nairobi is 330 miles and the power will be carried by the Uganda Electricity Board's 132 kV system to Tororo and thence by the Kenya Power Co.'s twin-circuit 132 kV transmission line to Nairobi. The overall design of the plant to be installed at the Nairobi receiving end will allow for the future possibility of the line from Tororo being tapped to provide a supply of electricity to the Eldoret-Kisumu area and the district surrounding Nakuru. Balfour Beatty & Co., Ltd., are designing the receiving station at Juja Road and the order placed with the B.T.H. Co. comprises the 132 kV and 66 kV oil circuit-breakers with their associated control and protective equipment, synchronous condensers, power transformers, and auxiliary switchgear. To provide for the control of power in the Nairobi area of Kenya and the local hydro-electric power stations at Wanji-Tana, the 66 kV switching station at Juja Road will become the focal point of this local system. Provision is being made to allow the 132 kV receiving station at Juja Road to be extended as and when any additional Kenya power sources are developed.

Copper Wire Rod Imports

The Board of Trade announced in Notice to Importers No. 711 dated 9th February, 1955, the establishment of a quota to be distributed in two half-yearly instalments for the import during the year commencing 1st April, 1955, of black hot rolled copper wire rods originating in and consigned from Canada and the United States of America. Applications for licences to import during the second half-year period are now invited from (a) agents of North American producers of rods, and (b) wire drawers in the United Kingdom. The applications should be submitted on Form ILB/A to the Board of Trade, Import Licensing Branch, 43, Marsham Street, London, S.W.1, not later than 1st September.

Greek Contract for Germany

A *Reuter* message from Essen states that the Krupp company of Essen has signed a contract worth more than £6,500,000 for the exploitation of brown coal deposits in Greece, and the building there of a briquette factory, a coke installation, and an electric power plant.

Kariba Hydro-Electric Scheme

The Federal Hydro-Electric Board of Rhodesia and Nyasaland has announced its intention to call for tenders for the main civil engineering work of the Kariba scheme on the Zambesi River. The work will consist of a large concrete arch dam across the gorge, complete with spillway, the excavation and construction of an underground power house with intakes and tail race tunnels, shafts and other ancillary works. It is expected that the work will commence in 1956 and will be substantially completed by the end of 1960. Contractors who wish to tender will be required to submit details of their qualifications and experience by the end of November next, after which tender documents and drawings will be issued to those who satisfy the requirements of the Board. A preliminary document outlining the work involved is available in this country from Sir Alexander Gibb & Partner, consulting engineers, Queen Anne's Lodge, London, S.W.1.

Plant Breeding Station in Wales

Opened by the Queen on 8th August during her tour of Wales, the new annexe buildings of the Welsh Plant Breeding Station at Gogerddan, Aberystwyth, are designed to facilitate research into plant growth, soil conditions and plant diseases. For the electrical installation of glasshouses, garner huts and many of the laboratories, British Insulated Callender's Cables, Ltd., have supplied considerable quantities of l.v. cable for over 500 lighting points and some 150 heating and general purpose outlets. Both p.v.c.-insulated and vulcanized-rubber-insulated cables were used while for the sub-mains installation 1,100 V mass-impregnated non-draining paper-insulated cable was used. The electrical contractor for this work was Tom Evans (Electricals), 25, North Parade, Aberystwyth.

Photographic-lamp Guide

Philips Electrical, Ltd., have published the 1955-56 edition of their "Photoflux" flashbulb booklet "Perfection in a Flash." The new edition has been enlarged to fifteen pages and completely revised. The speed tables have been adjusted so as to include the new ultra-high speed films: the tables of guide numbers for colour photography, arranged for quick and easy reference, apply to the latest emulsions. Full details are given also of the several other types of photographic lamps manufactured by Philips, together with hints on their uses. A new "Snap" leaflet has also been prepared. It is designed to assist the beginner in obtaining the best results from the use of "Photoflux" flashbulbs. Copies of these publications may be obtained from the company's Special Lamps Department, Lighting Division, Century House, Shaftesbury Avenue, London, W.C.2.

Cable Price List

The Rubber and Thermoplastic Cable Manufacturers' Association has issued to the trade Supplementary R.C.M.A. Minimum Trade Price List No. 2A which came into force on 15th August. It has also circulated No. 2 of a series explaining the developments and aims of the Cable Makers' Association which bears a list of C.M.A. members.

Japanese Radio Links

An order has recently been received by Standard Telephones & Cables, Ltd., through its associates the Nippon Electric Co., Ltd., Tokio, for an extensive standard s.h.f. radio network

for installation in Japan. This will cater simultaneously for telephone and television requirements between Osaka and Fukuoka over a route distance of about 385 miles. Three both-way radio channels are being equipped to provide an initial 240 telephone channels and one two-way 525-line television channel. Switching facilities will enable the third channel to be used as a stand-by for either television or telephony. The network comprises a total of eleven intermediate repeaters, nine of which will be unattended.

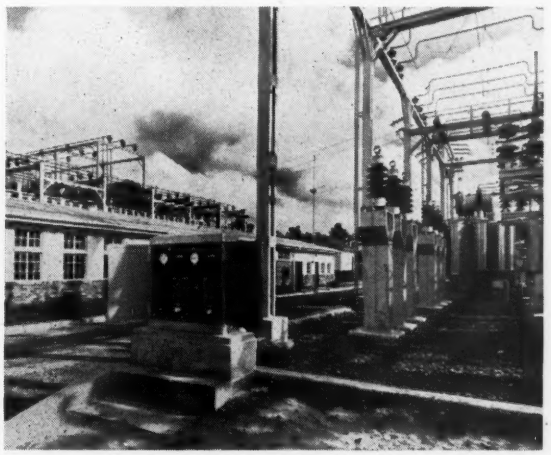
"Keep Your Motors Running"

For many years Brook Motors, Ltd., have published a small bound volume "Installation and Maintenance of Electric Motors," over 100,000 copies of which have been distributed and sold throughout the world. As the book has increased in size, printing costs have risen far beyond the original charge of 1s per copy, and in view of this the company has now introduced an abridged version priced at 1s under the title of "Keep Your Motors Running." The 128 pages contain a great deal of information of use to the motor user. Motor construction details, a lengthy list of horse-powers required to drive a wide variety of machines, installation and maintenance information, and a fault finding section, are some of the more important items. Connection diagrams, tabular information and a section on control gear complete the book, which is bound in stiff red cover paper. Copies may be obtained from the Publications Dept., Brook Motors, Ltd., Empress Works, Huddersfield.

First I.P. Cable in Africa

The first impregnated pressure cable to be installed in Africa recently went into service. It has been laid between Salt River power station and Oakdale substation, a distance of approximately 12 miles, as part of the Cape Western system of the Electricity Supply Commission of South Africa. The cable, operating at 66 kV, is the first of two feeders linking the Salt River power station with the substation at Oakdale and the second, laid concurrently with the first, is expected to be in commission very shortly. The cables are 3-core, mainly with conductors of 0·35 sq in although on some sections these have been increased to 0·5 sq in. The feeders will carry approximately 90 MVA. Manufactured by British Insulated Callender's Cables, Ltd., they were laid by the Electricity Supply Commission which employed British Insulated Callender's Construction Co., Ltd., in a supervisory capacity for this work.

The contract, which was obtained by British Insulated Cables (S.A.), Ltd., also includes the provision of an additional 33 kV solid type feeder laid between Salt River power station and Elsie's River substation, approximately seven miles away.



Oakdale distribution station showing gas control kiosk and sealing ends for 66 kV impregnated pressure cable

Rectifiers for Netherlands Railways

The General Electric Co., Ltd., has been entrusted with a further contract for pumpless steel-tank rectifiers for the expansion of the electrified sections of the Netherlands Railways. The order covers nine 1,224 kW, 1,500 V, twin-cylinder units fitted with electronic arc suppression equipment, and brings the total quantity of rectifiers supplied and on order for this administration in the post-war period to 100 cylinders with a combined rating of 60,000 kW.

Water Purification

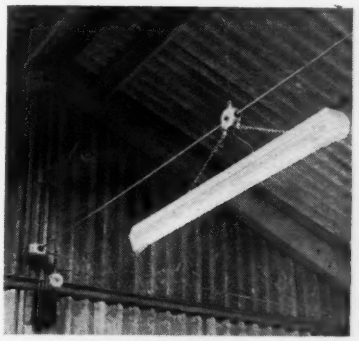
Great Britain has joined an international scheme for research on desalting saline waters by electrodialysis, in consequence of the ever increasing demands for fresh water with the rise of living standards. Authorities in places as far apart as Norway and Australia, Hong Kong and San Francisco, are discovering that they may soon have to think of using brackish water, and perhaps even seawater, and Great Britain is no exception, in spite of its rainfall; for instance, seawater is infiltrating into fresh water wells in the Thames estuary and it is becoming more and more difficult to suggest other sources that do not involve expensive, long-distance pumping.

Thus talks on the possibilities of various methods of desalting water have been going on for some time under the auspices of O.E.E.C., and one promising process is electrodialysis — the removal of salts from a liquid flowing between pairs of ion-selective membranes, by means of an electric field. Research on this method is already well advanced in the Netherlands. The Dutch recently offered to carry out development work in co-operation with other countries showing an interest. Great Britain has joined the Netherlands, South Africa, Australia and Algeria (representing France) in paying for this work and it has now begun. The problems to be solved are mainly those of bringing up the process from small to large pilot plant scale.

Industrial firms interested in desalting, particularly evaporation and distillation procedures, or in electrodialysis, are asked to communicate with the Department of Scientific and Industrial Research, Charles House, 5-11, Regent Street, London, S.W.1.

Farm Wiring Installation

The South Eastern Electricity Board, East Cross, Tenterden, Kent, has recently completed an interesting farm wiring installation, using the Enfield grid suspension wiring system, at Plurenden Manor Farm, High Halden. The farm, which is the property of Mr. Rudi Sternberg, has been considerably extended over the past eighteen months and it includes a new 3-bay milking shed to accommodate the Plurenden herd of 102 T.T. attested pedigree Friesians. Three runs of grid suspension cable are fitted in each bay of the milking shed and each run supports eight 80 W fluorescent lighting fittings. The grid suspension system is also used in several long runs to supply the outbuildings housing other animals and poultry batteries. Each outbuilding is divided into several units, the grid suspension cable being run through the dividing walls just below roof level. Approximately 1,350ft of twin- and three-core Enfield grid suspension cable and ninety-three connection boxes were used in this installation.



Main switch and distribution board, and the grid suspension supply in the milking shed at Plurenden Manor Farm

Iranian Radio Contract

It is announced that the Government of Iran is to modernize its radio communications system to Europe and overseas countries by the setting up of

a high quality independent sideband radio telephony and telegraphy service. Despite intense competition from other countries, an order for the supply and installation of the receiving equipment has been gained by Marconi's Wireless Telegraph Co., Ltd. In addition, Marconi's are to train Iranian engineers in the use of the equipment. Some of this training will take place at Chelmsford works, and at the Marconi College. The order includes the supply and installation of Marconi type HR11 double diversity h.f. telegraph receivers, single path i.s.b. receivers type HR21, frequency shift duplex receiving units type HU14A, tone senders type HU42, tone converters type HU11, Marconi-Siemens terminal equipment type HW21, Marconi-Siemens channel shifting and restoring equipment type HW41, and comprehensive quantities of spares, ancillary equipment and test-gear. The contract was awarded by the Iranian Ministry of Posts, Telegraphs and Telephones.

Production Management

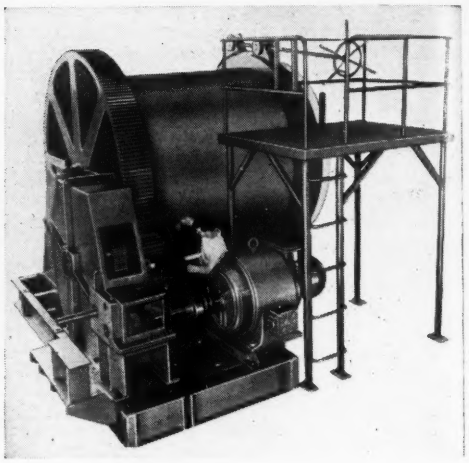
The Society of Industrial Engineers in association with the Work Study Society is holding a week end study conference on 4th and 5th November, at St. Ermins Hotel, Westminster, S.W.1, on the subject of "Aids to Effective Production Management." Its purpose is to show the value of Work Study Data for the Planning and Control of Output and Costs and also to discuss means for the solution of the problems involved. The conference is open to non-members. Particulars can be obtained from the hon. conference organizer, The Society of Industrial Engineers, 28 Victoria Street, S.W.1.

Air Navigation Beacons

Orders for forty-six air navigation beacons and communications transmitters have recently been placed with Redifon, Ltd., by the Indian Civil Aviation Department. The new contracts call for eight Redifon G.142 locator and holding beacons, and thirty-eight Redifon G.40s. Twenty-three G.40s will be employed as locator or route marker beacons and for broadcasting meteorological reports, while the remaining fifteen will operate on point-to-point and ground-to-air links. The Redifon G.142s will be dual installations, comprising two transmitters, each with their own power units. An automatic changeover device will switch on the reserve transmitter should the one in use not radiate correct signals at full carrier power with adequate modulation.

Haulage Winch Motor

The Australian firm of Hoskins Engineering & Foundry Pty., Ltd., recently supplied the Victoria State Electricity Commission with a 150 h.p. heavy duty 2-speed haulage winch for the positioning of heavy pipe work on the Kiewa Project. The winch has a drum with a capacity for 5,500ft of $4\frac{3}{8}$in circumference rope, and is capable of hauling 15 tons at 120ft per minute or 4 tons at 450ft per minute. A drum type indicator for the accurate positioning of loads is incorporated and is electrically interlocked in such a way that the operation of the winch is completely safe. The 150 h.p. pipe ventilated slip ring electric motor which drives this machine was made by Brook Motors, Ltd., Huddersfield, and was supplied through its agents for Western Australia, Carlyle & Co., Ltd., of Perth.



Heavy duty haulage winch incorporating a 150 h.p. Brook motor supplied to the Victorian State Electricity Commission

Educational

The L.C.C.'s annual guide to evening classes, "Floodlight," is now on sale at the bookstalls and in the bookshops, price 6d (by post eightpence). It appears this year in an attractive new binding, displaying an aerial view of London with a floodlight on County Hall. Its pages provide an introduction to the wide range of instruction available. There are more than 500 subjects listed, and in addition to the usual courses in electrical engineering there are courses in electricity supply administration and lectures on space travel and atomic development, nuclear physics and radio-activity. The present-day emphasis on industrial development and "automation" is reflected in the courses available in industrial experimentation and control techniques, electronics, time and motion study, industrial relations, management studies, foremanship, and television. The addresses of the various colleges and institutes are given together with the fees for the various courses.

Ferranti Trade Shows

Displays of electric fires and clocks and the "Fridge-Heater" have been arranged for the trade by Ferranti, Ltd. One is to be held at the Grand Hotel, Birmingham, from 23rd to 26th August and the other at the Black Boy Hotel, Nottingham, from 30th August to 1st September.

Protective Systems Guide

A publication of A. Reyrolle & Co., Ltd.—"Reyrolle Protective Systems" (pamphlet No. 858/7-55) should be particularly useful to distribution and control engineers and the like. It has been prepared to serve as a quick reference guide in the selection of systems most suitable to meet specific conditions. The list is broadly classified under the headings of: Feeders and teed feeders; transformers; transformer/feeders; generators; generator transformers; busbars; and reactors. Under each of these headings appropriate information is given under the following headings: System of protection; main features; connecting link between ends; and main equipment per feeder-end or circuit. The time characteristics of the relays incorporated in the systems are given in accordance with B.S.142 as follows: Instantaneous, class 60; i.e., operating time not more than 0·06 sec: Instantaneous, class 120; i.e., operating time not more than 0·12 sec.

Management Conference

The British Institute of Management announces that its National Conference this year will be held at Harrogate from 2nd to 4th November. Speakers who have already accepted invitations to address the conference include Mr. J. Diebold, American pioneer of the application of "automation," Sir Geoffrey Vickers, V.C., and Sir Charles Goodeve, O.B.E., F.R.S., director of the British Iron and Steel Research Association. The programme will include two plenary sessions and twenty-four sectional meetings devoted to specialized aspects of management.

Trade Announcements

The **Bective Electrical Co., Ltd.,** has moved to new and larger office premises at 40-42, Parker Street, Kingsway, London, W.C.2 (telephone: Chancery 9168 (5 lines)). The address of the Stores Department will in future be 49, Goding Street, Vauxhall, London, S.E.11 (telephone: Reliance 5725).

The **Igranic Electric Co., Ltd.,** announces that Alan Colless Pty., Ltd., has appointed Clark-Strickland Pty., Ltd., 17, McKillop Street, Melbourne, C.1, Victoria, Australia, to act as its agents for Igranic motor control gear throughout the State of Victoria.

The Cardiff office of the **Hotpoint Electric Appliance Co., Ltd.,** is 86-88, Adam Street (telephone: Cardiff 32318).

WORLD ELECTRICAL MARKETS

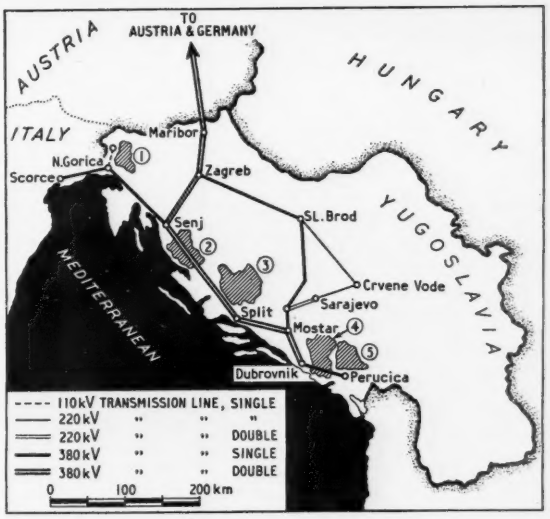
Trade with Yugoslavia

By R. E. KAAN, Dipl.Ing.

YUGOSLAVIA'S organization for the direction of social services, industry and other economic activities is self-governing and made up of representative Federal Councils which include members from the constituent Yugoslav republics. Liaison with the political state takes place only in the Federal Economic Council—the supreme policy-making body. Enterprises which are run according to co-operative principles are independent and self-governing and act on their own initiative. They are allowed to retain part of their profits for distribution among their workers.

Providing enterprises can produce evidence of the necessary experience and organization, permits to engage in foreign trade are issued. On this basis some of the larger factories import on their account, while Government and smaller enterprises rely on the services of import organizations, some of which are staffed with qualified technical experts to advise customers on the purchase of goods and to examine offers and quotations submitted by foreign firms. As German is the second language in many parts of the country commercial correspondence, particularly on highly technical subjects, should be in that language.

The agency enterprises, at present 492, represent a total of about 800 foreign principals including 130 British, 280 German, 60-70 each Austrian, French, Swiss and Italian,



Map showing principal power developments. Projects are shown as follows:—(1) Idrijca, (2) Lika-Gacka, (3) Cetina, (4) Trebisnjica, (5) Perucica

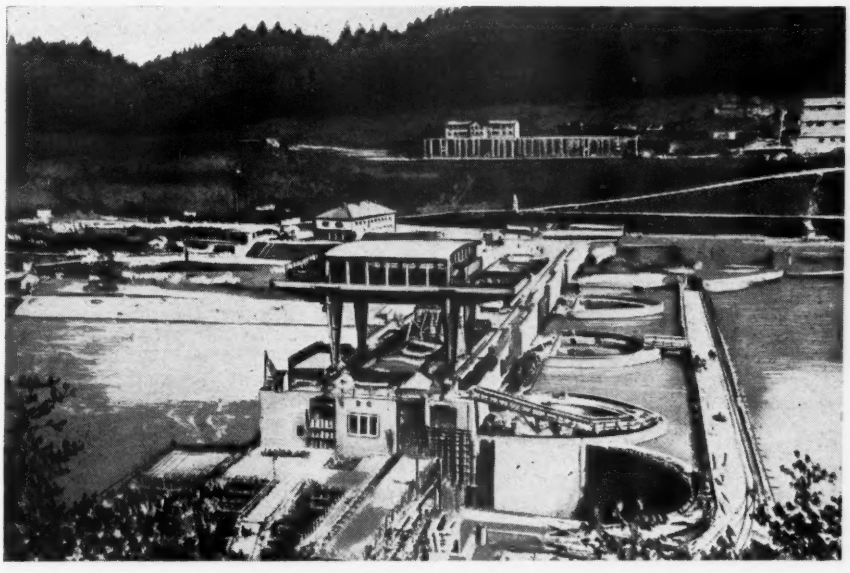
and 20-40 each Swedish, Dutch, Belgian and American. To finance the importation of capital equipment, efforts are being made to increase Yugoslavia's traditional exports (mainly agricultural products and timber).

Import organizations, being general importers, as a rule do not promote sales of any particular firm's products. They await orders from their clients, and place these with the foreign firms which offer the best terms as regards price, delivery time and quality.

Under the Yugoslav law, foreign firms are not permitted to appoint private individuals as their agents. Agency firms, though unable to import on their own account, can act as middlemen to bring foreign firms into contact with local buyers. These agency enterprises can perform any or all of the following services: operations leading up to sales; sales on behalf of foreign firms; after-sales technical services; and the holding of consignment stocks on behalf of foreign firms. A "co-efficient" system, designed to iron out the difference between Yugoslavia's domestic and world prices, imposed a desired pattern on overseas trade by discouraging the importation of non-essential commodities and protecting the country's own industries.

Exporters can retain a percentage of their foreign exchange earnings, the remainder being placed at the disposal of the Government to be used for defence and key imports. Producers and exporters not using their share of foreign exchange themselves, can sell it to would-be importers at rates determined by the state of foreign exchange.

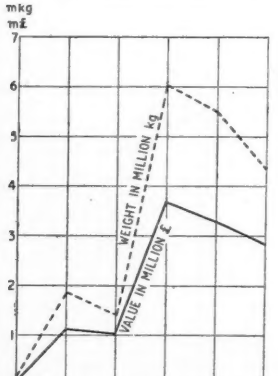
Yugoslavia's electrical imports between 1947 and 1954 are shown in Table 1.



Vugenica power station under construction

TABLE 1.—YUGOSLAVIA'S ELECTRICAL IMPORTS, 1947-1954

Year	Weight (tons)	Value (£ million)
1947	6,600	2·2
1948	11,700	4·5
1949	9,100	4·1
1950	10,400	3·2
1951	8,300	4·2
1952	14,300	9·4
1953	12,700	8·9
1954	10,200	7·1



Yugoslavia's imports from Western Germany

TABLE 2.—ANALYSIS OF YUGOSLAV ELECTRICAL IMPORTS

Source	1953 (£ thous.)	1954 (£ thous.)	Inc. or dec. %
United Kingdom	706	1,068	+50
United States	1,220	610	−50
Western Germany	3,300	2,850	−13
Austria	1,010	780	−23
Italy	760	510	−32
Switzerland	1,401	1,203	−15

TABLE 3.—YUGOSLAVIA'S POWER DEVELOPMENTS

Project	Installed capacity (MW)	Estimated cost of mech. and elec. equipment	
		($ thous.)	% of total ($ thous.)
Perucica	216	10,177	28·0
Cetina	530	15,810	16·7
Lika-Gacka	242	6,750	16·5
Idrijca	112	5,140	11·2
Trebisnjica	840	32,400	28·5

TABLE 4.—ELECTRICAL PRODUCTION FIGURES

Year	1939	1946	1947	1948	1949	1950	1951	1952	1953	1954 1st 10 mths.
Rotating machinery (MW)	4·3	8·4	29·6	79·8	144·8	196·7	157·7	259·5	291·0	189·0
Transformers (MVA) ...	0·03	3·7	47·4	77·3	168·2	116·7	301·8	412·5	612·5	442·4
Cables (tons)	1	33	374	647	1,047	714	1,734	2,284	3,009	1,924
Accumulators (tons) ...	115	272	516	841	1,145	1,165	999	1,309	1,637	1,381
Meters (No.)	—	—	32	29,609	61,000	155,418	30,911	85,392	139,732	61,753
Index of elec. production	100	145	222	413	588	576	630	807	1060	1209

Table 2 deals with Yugoslavia's imports from various countries during 1953-54. Although her total electrical imports during the last year decreased from £8·9 million to £7·1 million the United Kingdom achieved an export increase of 50 per cent, while Germany in spite of losing ground during 1954 as shown in the accompanying graph, still remains Yugoslavia's main supplier.

In 1949 Yugoslavia took 15 per cent of her total electrical imports from Western Germany. This figure increased to 37 per cent in 1953 and again to 40 per cent in 1954.

The fact that Yugoslavia in 1953 had only developed 3 per cent of her estimated hydro-electric potential led to the setting up of an inter-governmental body styled "Yougelexport," comprising quadripartite committees composed of representatives of Western Germany, Austria, Yugoslavia and Italy, to study future power developments, in order to meet the growing home demand and economically export considerable quantities of power to the neighbouring countries over long periods. Yugoslavia's production increased from a total of 2,700 milliard kWh in 1952 by 9 per cent to 2,937 milliard kWh in 1953, out of which 1,423 milliard kWh was from water power in 1952, and 1,540 milliard kWh in 1953. Yugoslavia's main power developments are shown in Table 3 and in the map on page 367.

The significance of the growth of local production is shown in Table 4.

The power projects mentioned should offer market possibilities for British manufacturers of heavy electrical plant, diesel generators, transmission and telecommunication equipment where demand outpaces local manufacture.

Welding Processes and Productivity

THE autumn meeting of the Institute of Welding will be held in London from 2nd to 4th November next and will comprise the annual dinner and the presidential address, followed by four technical sessions devoted to the presentation and discussion of papers on various aspects of the inert-gas arc welding processes. The principal guest at the dinner will be Mr. F. J. Erroll, M.P., Parliamentary Secretary to the Ministry of Supply, and Sir Edward Boyle, Economic Secretary to the Treasury, has also accepted an invitation to attend.

The spring meeting of the Institute will be held in the Eastern Counties next year from 3rd to 5th May. The Institute also announces that it is convening a conference on the Function and Education of Welding Engineers to be held in September, 1956.

The British Welding Research Association is arranging a number of meetings on increasing productivity by the use of welding to be held at various centres throughout Great Britain. The first meeting is to be in Glasgow on 20th and 21st September next, at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2, and will be opened by the Lord Provost of Glasgow. Addresses will be given by Mr. F. E. Rogers, chief of the Productivity and Technical Co-operation Division of the United States Operations Mission to the United Kingdom, and by a representative of the British Productivity Council. The following are the papers to be presented at the meeting and the authors:—"Recent Developments in Welding Steels" by A. R. Muir, B.Sc.; "Recent Development in Non-ferrous Resistance Welding" by P. T. Houldcroft, B.Sc.; "Improving Quality and Reducing Costs by Resistance Welding" by J. E. Roberts, M.Eng., A.I.M.; "Recent Developments in Non-destructive Testing" by H. L. Carson, B.Sc., A.Inst.P.; "A New Method of Designing Structures" by G. M. Moir, B.Sc., Ph.D., M.I.Struct.E., A.M.I.C.E.; and "What Can be Done to Reduce the Possibilities of Fatigue Failure and Brittle Fracture" by A. A. Wells, B.Sc., Ph.D. There will also be study groups to discuss research ideas of immediate practical value to those concerned with welding and a final statement of conclusions at the end of the meeting.

Admission will be by ticket which may be obtained free of charge from The Organizer, Glasgow Meeting, Welding Productivity, 8, Northumberland Street, Edinburgh, 3.

Whose Employee ?

The Temporary Transfer of Labour

By C. F. MAYSON, A.M.I.E.E.

WHEN a firm of contractors is engaged in work on a customer's premises, it is quite common for the customer to lend a man to assist them in, say, unloading equipment, handling it during erection, or performing other labouring work. Similarly, those who hire out machines such as mobile cranes usually provide the services of an operator, who must, of course, do his work under the instructions of the hirer. Supposing that an accident happens to the "borrowed" employee, who is responsible? That, and similar questions, are constantly arising, and it is as well to know to what extent and in what circumstances one may be under some liability either to, or because of the acts of, a "borrowed" employee.

A contract of employment is a contract of service whereby the employee agrees to work for the employer in return for the payment of wages or salary. It is an implied term of the contract that the former shall serve the latter faithfully and to the best of his ability. The employer, on the other hand, impliedly undertakes to exercise reasonable care in providing safe and suitable tools and equipment and a safe place in which to work, and in organizing and maintaining a safe system of work. Arising out of that undertaking, he is vicariously liable should one employee be injured due to the fault of another, or some third person suffer accident or loss through the negligence of an employee in the course of his employment; that is additional to his direct liability to the employee himself.

The question is, to what extent is he liable in the case of a temporary employee who is actually employed by someone else? On the face of it there is no liability at all, for the temporary employee is under a contract of service with his permanent employer, and nothing can alter that relationship without the specific agreement of all parties, including that of the employee.

The law has from time to time created what may be termed "devices," in order that blame may be placed upon the shoulders of those who should properly bear it. One such device is that an employee who has been lent by his permanent employer to a temporary employer is deemed, for the time being, to be in the employment of the latter. By this means the permanent employer's liability under the contract of service (that is, the liability outlined above) is shifted to the temporary employer. This is fair and just, for the man's own employer cannot, in equity, be expected to take the blame for something over which he has no control.

Conception of Temporary Employment

The device of temporary employment is somewhat restricted in practice. On the authority of the House of Lords in *Mersey Docks and Harbour Board* v. *Coggins & Griffith (Liverpool), Ltd.*,* the transfer to the temporary employer must be so complete that there is a right to dictate not only what the employee is to do but also how he is to do it. It is extremely doubtful whether that would occur in the case of the driver of a lorry or the operator of a crane; although he must be told what he is to do (and perhaps, in some respects, how he is to do it), it is not to be contemplated that he will be shown how he is to drive the lorry or operate the crane. Similarly with a skilled technician. Use of the device is, in fact, normally confined to unskilled labour, for it is more easily inferred in those circumstances that the temporary employer will have complete control of both the method and manner of doing the work.

A recent case, *Denham* v. *Midland Employers' Mutual Assurance, Ltd.*,† illustrates the limits of this conception of temporary employment. A firm of brick makers employed contractors to carry out some trial borings, and the latter agreed to provide two skilled drillers with plant and equipment, the former supplying unskilled labour in the person of one Clegg, a regular employee. Whilst working with the contractors' men Clegg was killed in circumstances which it was agreed made the contractors liable to his widow. They were insured under two policies. The first was an employers' liability policy covering liability to "any person under a contract of service with the insured"; the second covered liability to the public. The Court of Appeal had to decide under which policy the liability fell.

It was established that Clegg worked as though he were one of the contractors' men, being under the orders of their foreman and working the same hours, including overtime, as the drillers; but his wages were paid to him by the brick makers, who also kept his National Health Insurance card. The Court held that, although he was the contractors' temporary employee in so far as liability for injury went, he was not employed by them "under a contract of service"; they were, however, covered by the public liability policy.

Occasional Duties

What of the cases which fall outside this device of temporary employment? What about the crane operator or the lorry driver, or the customer's man who helps with the unloading? At the lowest, these persons will be in the position of members of the public who are on the premises of another for the purpose of business in which they are both interested; they will be the "invitees" of the occupier. Liability to such persons is limited to taking reasonable care, by warning or otherwise, that they are not exposed to dangers which they cannot be expected to foresee. There is no liability for injury to third parties by their acts, for in that event they have the duties of the occupier thrust upon them (although it is possible that the permanent employer might be held vicariously responsible).

In this connection, "premises" is not confined to land or buildings, but includes railway carriages, road vehicles, ships and temporary erections such as staging or scaffolds; and the "occupier" is the person who has control over the use of them. So the man lent by the customer to unload the contractors' van could just as easily be the latter's invitee as if he were driving a hired crane in the contractors' own works.

* Law Reports (1947) Appeal Cases 1.
† (1955) 3 Weekly Law Reports 84.

Although the operator of a mobile crane will usually be the invitee of the hirer of the crane, it is possible for the relationship of employer and employee to arise as the result of a dangerous situation being created by the temporary employer. *Holt* v. *W. H. Rhodes & Son, Ltd.*‡ provides a good example.

The plaintiff was in the general employment of the owners of an electrically-driven mobile crane, which was on hire to a firm of stevedores. The crane driver, who was the plaintiff, was lent with the crane, and took orders from the stevedores merely as to the work he had to perform. On the occasion in question the electrical lead from the crane was plugged into a socket fixed on a pillar at about twelve feet from the ground. The driver was asked to move the crane, which he could not do until he had disconnected the lead. The stevedores had piled cargo around the pillar, and the driver was compelled to climb over the cargo in order to reach the socket. While doing so he fell and was injured.

The Court of Appeal held that the stevedores were liable to the driver as a temporary employee for, although he was, in general, their invitee, they were under a duty to provide a safe system of working for any operation of which the control had passed temporarily to them.

On premises which come within the definition of "factory" in the Factories Acts, it is the occupier who is responsible for safety. This liability is additional to that already discussed in cases where the occupier is also the employer. The duty under the Acts as to safety is to "all persons employed," and this will, of course, include the driver of a hired mobile crane. The Acts do not displace the common law rules, although the duties under both may sometimes be co-extensive.

What it amounts to, then, is this. Where the customer lends one of his employees to the contractor for the purpose of providing unskilled labour, that person will be deemed to be in the temporary employ of the contractor so far as employer's liability is concerned. If he is lent merely on some isolated occasion, such as to help in unloading a lorry, he may be merely an invitee, but the facts might show him to be in the position of a temporary employee. Skilled men, including those lent with hired machinery, are, on the face of it, invitees; but, here again, the creation of a dangerous situation could raise the presumption of temporary employment in respect of that situation. The Factories Acts supplement, and do not alter, the position.

‡ (1949) 1 All England Reports 478.

Electrical Progress in Arabia

A NEW 33 kV line from the power station in Aden to Sheikh Othman and beyond to Bir Nasir, has been completed. More supplies of electricity are now available both for the Sheikh Othman bore wells and Sheikh Othman town. This line, 16 miles long, is the first 33 kV line to be constructed in Southern Arabia. Priority was given to this work because without electricity at Bir Nasir it was not possible to improve the water supply of the Colony. Power for operating the new pumps at Bir Nasir is now available at the site of the new bore wells.

The increased demand for electricity during the summer months places a severe strain on the Aden Electricity Department. Some figures showing the expansion of the Department have been issued. During the year ended March, 1952, the heaviest load on the Aden power station was 1,800 kW and just over 12 million kWh was generated during the year. In the year ended March, 1955, the load rose to 4,700 kW and the kWh generated to approximately 24 million. At the present time the heaviest load is 5,300 kW and the kWh generated is at the rate of 30 million per annum; this has been possible only because of the completion of the first unit in the new power station and the renewal of the distribution system at its weakest points during recent months.

Restrictions were placed on all electricity supplies in the Colony in 1947, when a waiting list of new connections was instituted, and it was not until 1952 that material progress was made in connecting new consumers. At 31st March, 1952, there were 5,384 consumers connected; three years later the number had risen to 9,439.

The old mains were designed many years ago for the output of the old station, and for a maximum load of only one-third of the present load; these mains are to a great extent inadequate and the same applies to switchgear, transformers and other equipment. A great deal of "patchwork" has had to be carried out rapidly to the old mains to enable them to carry the heavier loads, and more must still be done. At the commencement of last winter, in anticipation of this summer's demand, a programme of work was undertaken to reinforce the system at its weakest points from December to May and a total of 22,000ft of h.v. and l.v. cable has been laid. Eleven new transformers have been installed of capacities from 100 kVA to 1,500 kVA, and four completely new substations have been built. While this work was in progress 500 new consumers were connected to the system. The total inadequacy of the mains was appreciated several years ago. Money has been provided for the reconstruction of the mains, but physical progress has been retarded because of the difficulty of recruiting staff from overseas to undertake this specialized work. Some staff has now been obtained and has recently been heavily employed in the construction of the new 33 kV line to Sheikh Othman and beyond to Bir Nasir. Now that this line is completed all available staff has been diverted to the urgent mains reconstruction necessary between the power station and the main pass for improving the supply to Crater. New mains, new substations and switchgear, etc., will later be installed in the Crater, Steamer Point, Khormaksar, and Sheikh Othman areas in order to complete a modern ring main distribution system for the Colony.

Wrought Aluminium Wire

BECAUSE of the increasing use of aluminium for electrical conductors of many types, the British Standards Institution has prepared B.S. 2627: 1955. This publication refers only to wire used for electrical conductors such as overhead transmission lines, insulated cables, or windings for rotating machinery or transformers, and is suitable for controlling the quality of wire supplies for electrical components made to other British Standards, such as B.S. 215, "Hard-Drawn Aluminium and Steel-Cored Aluminium Conductors," and B.S. E.21, "Electric Cables for Aircraft."

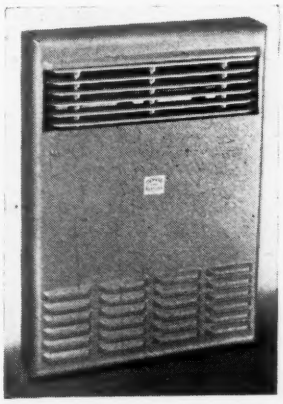
Wire for general engineering and other purposes is specified in B.S. 1473, "Rivet, Bolt and Screw Stock for Forging," and B.S. 1475, "Wire," which forms part of a comprehensive series of standards for aluminium and aluminium alloys for general engineering purposes (B.S. 1470-77) now being revised.

The present standard is the first of a similar series of standards for wrought aluminium alloys for electrical purposes. The system of nomenclature adopted in this standard is cognate with that employed in the general engineering series. Copies of the new standard may be obtained, price 2s 6d, from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1.

NEW ELECTRICAL EQUIPMENT

Convector Heaters

The range of wafer type convector heaters made by SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., 38-39, Upper Thames Street, London, E.C.4, for the shipbuilding industry are now available for the general market. These neat and compact heaters are built to have infinite life with no attention whatsoever and certain of the requirements of ocean-going vessels have been retained and are proving themselves in office, factory, shop, and in the home. The black heat elements are iron free and are available in two main types: the uncooled outer casing, suitable for factories and many out-of-



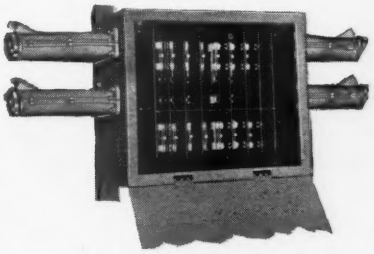
Siemens wafer type convector heater

reach positions; and the cool outer casing type having in the instance of the 1 kW size a nominal surface temperature of 110 deg F, which is recommended wherever people can come into contact with the heater. The depth of all units is 3in and when mounted on wall brackets, which are standard, the projection is 5in. Free standing and back to back models are available.

The 500 W, 1 kW and 1½ kW range has a height of 24½in, the width being 17½in. Internal lamps, switches and half heat switches can be provided. The prices range from £6 to £11, depending on the fixing and control requirements, plus purchase tax in the United Kingdom. The 2 kW size measures 30½in high by 25½in wide, and prices range from under £8 up to £13, plus purchase tax.

Link Box

ENFIELD CABLES, LTD., Victoria House, Southampton Row, London, W.C.1, have brought out a new 6-way sheet steel fabricated wall mounting link disconnecting box having a hinged lid. The interior of the box is equipped with 300 A busbars and connection post fitted with "Coslok" links



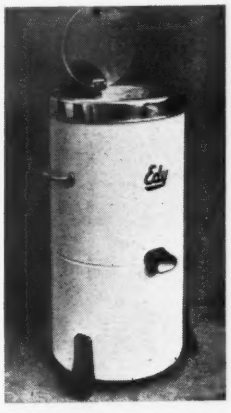
Enfield wall mounting link box

on 3¾in centres. The sealing boxes on the left-hand side, right-hand side, and the base are suitable for 0·30 sq in 4-core p.i.l.c. & a. low voltage cable.

Spin Dryer

The introduction of their new model C.III spin dryer is announced by EDY (GREAT BRITAIN), LTD., Farnley Low Mills, Whitehall Road, Leeds, 12.

The machine is fitted with a transparent cover and incorporates an automatic brake system. To start it, it is necessary to close the lid and when this is raised the motor is stopped. The drum revolves at approximately 1,460 r.p.m. and the

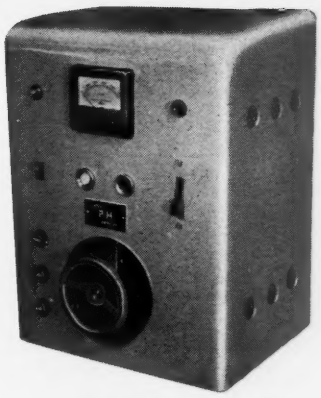


Edy model C.III spin dryer

consumption is 100 W. It dries about 28 lb of wet clothes ready for ironing in 3 to 5 minutes. The finish is of vitreous enamel, both inside and out, and the rim is of polished aluminium. Lifting handles are provided and it is of a convenient height to fit easily under the sink. The price is £31 10s, plus £11 10s 4d purchase tax.

Motor Speed Controller

PRECISION HEATING, LTD., 142a, Canbury Park Road, Kingston-on-Thames, have developed a controller to provide an infinitely variable speed of f.h.p. d.c. motors up to 1 h.p. This operates from a 230 V, 50 c/s single-phase supply and provides a speed



P.H. speed controller

range of up to 30:1 at substantially constant torque. Operation is instantaneous from cold, and a push-button control for the motor is provided. Smooth stepless speed control throughout the range is given and a speed indicator is fitted.

Two models, the 25 and the 100, are available, the first for motors up to ¼ h.p. and the second up to 1 h.p. Specially wound d.c. motors are used.

Dry Shaver

The Shaver Division of REMINGTON RAND, LTD., 24-40, Kensington High Street, W.8, announces the introduction of the "Super-Sixty" dry shaver, available from 1st September.

Of completely new design, with new-type spring loaded cutters, it is claimed to give a closer and faster shave than hitherto possible. It has four rows of surgical steel cutters and the double-insulated a.c./d.c. motor, radio and T.V. suppressed, revolves at a speed of 9,500 r.p.m.

The regular model is suitable for the 210-240 voltage range and the triple-volt model has a switch which can be set to 110-130, 140-160 or 190-240 V. The prices of the shaver, which is presented in a suede finish case, is £8 6s (regular) and £9 3s (triple volt) plus £1 11s 11d and £1 14s 11d, respectively, for purchase tax in the United Kingdom.

Concurrent with the introduction of the "Super Sixty" the price of the Remingon "Sixty" regular model will be reduced to £7 2s 4d, plus £1 7s 8d purchase tax.

Remington "Super-Sixty" dry shaver

REPORTS and DIVIDENDS

OUR Stock Exchange correspondent is away on holiday for a fortnight and so this week and next his usual notes and comments will not appear. The tables of prices of stocks and shares appear as usual.

The Revo Electric Co., Ltd.—The annual meeting was held on 10th August, Mr. W. L. Barrows (chairman) presiding. The statement accompanying the report and accounts, said that the improved results were mainly due to the steps taken to reorganize the production of the company. Costs still tended to rise, but every effort was being made to offset their effect by further improvement in methods of manufacture. By continual development and the success of its new designs of cookers and lighting in particular, the company had maintained its competitive position. The consumer goods side of the business had been adversely affected by the hire purchase restrictions imposed early in the year. In spite of adverse factors, the directors expect the company's earning capacity to be maintained during the current year.

Associated British Engineering, Ltd.—In his statement, which is circulated with the report and accounts for the year to 31st March last, Mr. L. W. Robson (chairman), refers to the purchase during the year of British Polar Engines, Ltd., and the acquisition at the end of the year of the outstanding interest in the Parsons Engineering Co., Ltd. The combined turnover of the manufacturing companies, despite more competitive trading conditions, has shown a marked increase over the previous year, not only as regards home sales, but also in sales to export markets. After mentioning the progress and activities of the principal subsidiary companies, Mr. Robson says that during the current year to date they have continued to be as busy as they were during the last year, and the demand for the group's products has been well up to expectations.

Thorn Electrical Industries, Ltd.—The consolidated trading profit for the year ended 31st March last is £1,501,612, as compared with £1,054,348 for 1953-54, and after meeting all charges including £520,307 for taxation, the net balance is £609,007 (against £315,566). General reserve receives £300,000 and it is proposed to pay an ordinary dividend for the year of 15 per cent on capital of £1,068,750 (including £528,750 issued by way of capitalization of reserves in May last). For the previous year the dividend on the former capital was 20 per cent. The balance carried forward in the accounts of the parent company is £103,621 (£73,704) and in subsidiary companies £80,818 (£37,384). The report and accounts have been issued in brochure form and

The Week's Price Changes

Company or Board	Nom. Value	Middle price 15th Aug.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	81½	−1	3	3	3 13 7	94½	81
Brit. Elec. 1974/77	100	78½x.d.	−2	3	3	3 15 0	93⅞	78
Brit. Elec. 1976/79	100	84½	−1	3½	3½	4 3 4	98⅜	84
Brit. Elec. 1974/79	100	98	+½	4½	4½	4 11 10	109	97½
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0	22/6	20/9
East African Power	£1	23/-	−1/-	7	7	6 1 9	24/6	19/9
Nigerian Elec.	£1	23/6	−6d	10	10	8 10 3	27/-	22/6
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	20/-	−6d	6	10	10 0 0	21/6	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/-		12½	17½	6 14 7	14/6	11/-
Aerialite	1/-	6/3		88⅛	88⅛	—	6/7	5/3
Allen, W. H.	£1	80/-	−3/9	20	20	5 0 0	83/9	77/-
Aron Elec. Ord.	£1	60/-		20	15	5 0 0	63/9	55/6
Assoc. Elec. Ord.	£1	92/6	+3/9	11½	14	3 0 6	96/-	65/3
Automatic Tel. & El.	£1	75/-		15	15	4 0 0	79/6	69/-
Babcock & Wilcox	£1	90/-	−5/6	12*	15	3 6 8	98/-	68/6
Baldwin, H. J.	2/-	5/-	−6d	20	20	8 0 0	5/6	4/4
Bakelite	10/-	33/6	−9d	12½	16	4 14 1	34/6	27/-
British Aluminium	£1	51/3	−2/9	10	12	4 10 7	58/-	35/3
B.I. Callender's	£1	48/6	−1/6	10	10	4 2 6	55/3	44/9
B.I. Callender's 6% Pref.	£1	23/-	−6d	6	6	5 4 4	26/6	23/-
British Thermostat	5/-	33/9		27½	27½	4 1 9	35/-	22/6
British Vac. Cleaner	5/-	8/-	−3d	25	30	—	10/-	7/-
Brook Motors	10/-	46/3		20	20*	—	45/-	39/9
Brush Ord.	5/-	9/-		6	10	5 11 0	9/6	7/7
Bulgin, A. F.	1/-	7/9		30	45	5 16 2	8/-	4/-
Burco Dean	5/-	13/9		35	25*	—	23/-	18/9
Chloride El. Storage	£1	70/-	−2/6	12½	17½	5 0 0	77/6	58/6
Clarke Chapman	£1	102/6		20	20*	3 18 1	102/6	68/9
Cole, E. K.	5/-	25/-	+1/6	27½	17½*	7 0 0	25/6	18/3
Cossor, A. C.	5/-	12/6		10	10	4 0 0	14/-	8/9
Crabtree	10/-	32/6		17½	20	6 3 1	34/6	29/3
Crompton Parkinson Ord.	5/-	17/-	−1/-	20	20	—	19/9	16/-
De La Rue	5/-	21/6	+1/-	20	30	6 19 6	26/-	18/9
Decca	4/-	42/6	+2/6	35	56½*	—	48/9	31/-
Desoutter	5/-	35/-		20	25	3 11 6	35/-	25/6
Dewhurst	2/-	10/-	−6d	19	24	4 16 0	10/6	7/3
Dictograph Tel.	2/-	7/9	+6d	20	20	5 3 3	7/6	6/6
Dubilier Condenser	1/-	4/9	−3d	25	25*	5 5 2	5/7	3/10
E.M.I.	10/-	27/-	−1/9	8	10	3 12 1	37/-	25/3
Electrical Components	5/-	18/9x.d.	−2/-	20	25	6 13 4	21/3	15/3
Elec. Construction	£1	35/-		15	8⅓*	4 17 2	41/3	31/6
Enfield Cable Ord.	£1	20/-	+1/3	Nil	Nil	Nil	25/3	20/-
English Electric	£1	82/6	+4/-	10	12½	3 0 7	86/9	54/3
English Electric 3½% Pref.	£1	14/9		3½	3½	5 1 9	16/9	14/9
Ericsson Tel.	5/-	40/-	−4/-	25†	20†*	2 10 0	46/6	29/-
Ever Ready	5/-	33/9	−1/9	40	35*	5 3 8	38/-	22/3
Falk Stadelmann	£1	45/9	−2/3	15	15	6 11 2	52/6	43/9
G.E.C. Ord.	£1	72/6	+3/-	12½	14	3 17 3	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 5	28/4	23/6
General Cables	5/-	15/3		30	30	9 16 9	17/-	15/-
Greenwood & Batley	£1	57/6		17½	17½	6 1 9	57/6	54/6
Hackbridge Cable	5/-	20/3	+1/3	20	20	4 18 9	22/6	14/-
Hackbridge & Hewittic	5/-	20/-		25	30	—	33/9	23/9
Hall Tel. Acc.	10/-	18/9	−9d	10	10	5 6 8	22/6	11/-
Heatrae	2/-	5/9		12½	15	5 4 4	5/9	4/3
Henley's	10/-	18/6	−6d	10½	10½	5 13 6	21/3	17/-
Holophane	5/-	18/-	−9d	20	25	7 2 10	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

include illustrations and notes on the activities of the companies of the group.

E. Shipton & Co. (Holdings), Ltd.—The trading profit for the year ended 31st March last is £70,926, and after deducting all charges, including £24,324 for taxation, the net profit is £15,694. It is proposed to pay a final dividend of 12½ per cent, making 22½ per cent for the year.

In his statement, Mr. E. Shipton (chairman) says that the company was converted into a public company in March last year. E. Shipton & Co., Ltd., engages in the design and manufacture of telephone and similar equipment, and since March, 1954, trade has progressed satisfactorily. The bulk of the trading is carried out through sale and rental agreements. Other products include the "Interecorder" magnetic tape recording equipment, and "Audion" and "Audistor" hearing aids. Last year the National Telewriter Co., was acquired, and its title is now National Telewriter (1955), Ltd.

Electrical Components, Ltd., reports a consolidated trading profit of £207,998 for the year ended 31st March last, compared with £138,907 for 1953-54. Adding non-recurring credits (£1,290) and deducting taxation (£109,129), the net sum available is £100,159, against £60,671. General reserve fund receives £50,000 (£10,000) and the contingencies and bad debt reserve £10,000 (£5,000). The ordinary dividend is maintained at 20 per cent but in addition a 5 per cent bonus is paid. A balance of £12,104 is added to the amount brought forward, making £115,520 to be carried to the next accounts. Application has been made for sanction to the issue of 234,907 new 5s shares to be offered to present shareholders in the ratio of one new share to each three held at a price to be announced later. In his review of the year the chairman says that the expansion of business is continuing, though not on such a marked scale.

Metal Industries, Ltd.—The group trading profit for the year ended 31st March last amounts to £806,485, as compared with £1,100,923 for 1953-54, and after adding investment income, the total is £1,032,890 (against £1,327,584). Taxation absorbs £353,456, and after deducting other charges there is a net balance of £284,072 (£332,950). The proposed dividend for the year is unchanged at 9 per cent. It is stated that the profits of the metal division improved but earnings of the electrical division were reduced by higher costs and the mechanical engineering division showed no improvement with results offset by development of new products not yet remunerative and by termination provisions for unsatisfactory contracts.

The English Electric Co., Ltd., has declared an interim ordinary dividend of 4 per cent. A similar dividend was paid a year ago, followed by a final distribution of 8½ per cent. Since then the capital has been increased following offers to acquire Vulcan Foundry and Robert Stephenson and Hawthorns' stock units.

Cable & Wireless, Ltd.—For the year ended 31st March last the profit before tax amounted to £1,828,220, which is £236,218 lower than for the previous year. From this the following appropriations have been made:—

In Electrical Investments

Company or Board	Nom. Value	Middle Week's price 15th Aug.	Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	45/6x.d.	−6d	45	70	7 10 6	52/6	40/-
I.C.I.	£1	53/-		15	10*	3 14 5	61/9	38/3
Intl. Combustion	5/-	22/-	+1/6	20	25	—	24/6	16/3
Johnson & Phillips	£1	44/6	+3/6	15	15	6 14 0	52/6	41/-
Lancashire Dynamo	£1	56/3		14	15	—	56/3	37/3
Laurence, Scott	5/-	18/-		20	12½*	3 9 0	19/6	14/6
Lister, R. A.	£1	36/-	−2/-	12	9·3*	5 3 4	40/-	30/6
London Elec. Wire	£1	54/3	−3/3	10	12½	4 11 9	61/3	50/6
Lucas, J.	£1	49/6	−6d	10·8	7½*	3 0 7	56/6	41/6
Marryat & Scott	2/-	12/3		25	30	4 18 0	13/-	9/6
Mather & Platt	£1	73/-x.d.	−1/-	15	13·4*	3 13 4	75/-	48/-
Metal Industries	£1	29/6x.d.		9	9	6 2 0	38/-	29/-
Midland Elec. Mfg.	£1	52/6		15	10*	3 16 2	55/-	44/-
Morphy-Richards	4/-	30/-		40	35*	4 13 4	35/-	27/-
Murex	£1	61/3x.d.	−2/6	15	15	4 17 7	66/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	4/-		17½	20	5 0 0	4/-	2/10
Parnall (Yate)	5/-	9/9		8	14-	6 16 7	13/2	7/3
Parsons, C. A.	£1	90/-	+2/6	7½	10	2 4 6	100/-	56/-
Plessey	10/-	76/3	+1/3	30	20*	2 12 3	89/-	57/6
Pye Deferred	5/-	43/9		20	12½*	2 17 3*	47/6	28/6
Revo	10/-	14/9		27½	9*	6 2 0	15/6	12/6
Reyrolle	£1	120/-	+4/-	13¾	15	2 10 0	127/6	89/-
Rheostatic	4/-	13/3		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	17/9	−3d	15	15*	4 4 6	19/-	11/-
Scottish Cables	4/-	19/6	−6d	27½	27½	5 11 0	22/6	19/3
Smith (England), S.	4/-	18/6	−1/-	15	17½	3 15 8	20/-	15/-
Southern Areas	£1	36/3	+2/6	7½	10	5 10 4	38/-	27/6
Strand Elec.	5/-	11/9	+1/-	17½	17½	7 9 0	11/9	8/6
Sturtevant	5/-	33/-	−2/6	18·9	14·4†*	2 3 9†	35/9	21/-
Sun. Elec.	£1	35/-		15	15	8 11 6	35/-	33/9
Switchgear & Cowans	5/-	17/-		10	20	5 17 9	17/-	11/-
Taylor Tunnicliff	5/-	15/3	+6d	12½	15	4 18 4	16/3	11/3
T.C.C.	10/-	53/9		30	25*	4 12 7	53/9	41/-
T.C. & M.	£1	32/-	−1/-	8½	8½	5 6 3	40/9	33/-
Telephone Mfg.	5/-	11/6	+6d	10	10	4 7 0	11/6	9/3
Thorn Elec.	5/-	25/-x.d.	+1/9	20	15*	3 0 0	33/-	13/9
Thornycroft	£1	45/-		15	15	—	47/6	34/6
Tube Investments	£1	102/6	+2/6	15	17½	3 8 4	107/6	72/6
Vactric	5/-	19/6		10	15*	3 17 0	22/-	12/-
Veritys	5/-	10/6		12½	12½	5 19 1	11/-	7/-
Walsall Conduits	4/-	16/9		70	70	—	67/6	50/-
Ward & Goldstone	5/-	37/6		50	30*	4 0 0	45/-	37/6
Watford	2/-	8/3	−6d	22½	25	—	8/9	6/3
Westinghouse Brake	£1	102/6		16	18	3 10 3	110/-	82/-
West, Allen	5/-	14/6	−9d	17½	15*	5 3 5	16/6	8/-
Wolf Electric	5/-	21/-		17½	20	4 15 3	21/-	16/1
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A. Ord.	100	70½	−8	6	6	8 10 2	88	72
Ord.	100	45	−5	3¾	3¾	8 6 8	54½	45
Anglo-Portuguese	£1	24/6	−2/6	8	8	6 10 7	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	21/-		50	22½*	5 7 0	24/3	19/6
Cable & Wireless:								
Ord.	£1	51/-	−1/-	9	10	3 18 5	54/-	39/6
4% Loan	100	92½	−2	4	4	4 6 6	100	92
Calcutta Trams	£1	25/6	+1/9	2½†	6†	4 14 1	26/-	20/-
Cape Elec. Trams	£1	19/-		5½	7½	7 18 0	19/-	16/6
Marconi Marine	£1	38/-	−2/6	10	10	5 5 3	41/3	33/-
Oriental Tel. Ord.	£1	82/6		16	16	—	102/6	96/6
Telephone Rentals	5/-	12/3	−6d	10	12½	5 2 0	13/6	9/6

taxation, £942,372, tax relief on investment allowances to capital reserve, £153,674, dividend of 4 per cent (unchanged), £690,000, leaving a balance of £42,174, to which is added £708,762 brought in, making £750,936.

The Nigerian Electricity Supply Corporation, Ltd.—The net profit for the year to 28th February last is £111,358, as compared with £111,044 for the previous year. It is proposed to pay a final dividend of 4 per cent and a bonus of 2 per cent, maintaining the distribution for the year at 10 per cent.

C.E.A. Issue.—Application lists for the issue of £200 million British Electricity 4½ per cent guaranteed stock, 1967-69, were open for only half an hour on Thursday last week. Applications for amounts of stock up to and including £250,000 have been allotted in full; applications for larger amounts received about 74 per cent of requirements with a minimum allotment of £250,000.

New Companies

Chilton Circuit Breakers, Ltd.—Registered 30th July. Capital £100. Manufacturers of and dealers in electrical switchgear, circuit-breakers, dynamos, motors, armatures, magnetos, etc. First directors: A. R. Ward and C. A. F. Shapcott. Solicitors: Theodore Goddard & Co., 5, New Court, London, W.C.2.

P. A. Baker, Ltd.—Registered 15th July. Capital £100. To acquire the business of a retailer of electrical contracting and other electrical appliances now carried on by P. A. Baker at Trayzee, Compton, near Newbury, Berks. Directors: P. A. Baker and Mrs. Jean O. Baker. Regd. office: 101, Bartholomew Street, Newbury, Berks.

Cefni (Electrical), Ltd.—Registered 19th July. Capital £5,000. Electrical engineers and general electrical installation contractors, etc. Directors: R. Wilson, Mrs. Ruby Wilson and Mrs. Ann Foster. Regd. office: 16, Bridge Street, Llangefni, Anglesey.

H. W. Evans & Sons, Ltd.—Registered 21st July. Capital £10,000. To acquire the business of electrical, mechanical and general engineers carried on by Herbert W. Evans as Evans & Co., etc. Directors: H. W. Evans, Mrs. Gertrude Evans and E. R. Evans. Regd. office: Station Road, Askern, near Doncaster.

Howard Industries, Ltd.—Registered in Belfast 4th July. Capital £500. Manufacturers, exporters and importers of, dealers in and agents for mechanical and electrical apparatus, appliances and fittings of all kinds, etc. Directors: Mrs. Margaret E. Howard and J. A. Howard. Regd. office: 3, Mayfair, Arthur Square, Belfast.

Liquidation

Chadfield's Inventions, Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. R. A. Haigh, Court Chambers, Friar Lane, Leicester, appointed 3rd August.

Bankruptcies

G. W. Altass, 1, Bruce Avenue, Shepperton, Middx, electrical engineer.—Application for discharge to be heard on 11th October at the Guildhall, Kingston-on-Thames.

S. Whitton and **L. Whitton,** trading in partnership at Church Place, Victoria Road, Leeds, 5, under the style of F. Whitton & Sons, electrical engineers.—Last day for receiving proofs for dividend 20th August. Trustee, Mr. R. B. Smith, 34, Kent Road, Harrogate.

C. A. Smith, 199, May Lane, Kings Heath, Birmingham, 14, lately carrying on business at 4, Gothic Arcade, Snow Hill, Birmingham, under the style of Birmingham Electrical Co., electrical contractor.—Public examination 2nd November at the Court House, Corporation Street, Birmingham, 4.

D. Cromwell and **V. I. Cromwell,** carrying on business in partnership as Cromwell & Co., at the rear of 76, High Street, Croydon, Surrey, and formerly at Hindsley Works, Hindsley Place, Forest Hill, S.E.23, and at a garage in Coombe Avenue, Croydon, and at 17, Streatham Hill, S.W.2, manufacturers of electrical fittings, lamp shades and a food product.—Order made 30th June suspending discharge of D. Cromwell for nine months until 30th March, 1956, and of V. I. Cromwell for three months until 30th September next.

MALAYA'S ELECTRICAL IMPORTS

Malayan imports of electrical machinery, goods and apparatus, after a drop in value between 1952 and 1953 of about 25 per cent, recovered last year and at a total of 69 million Malayan dollars showed a rise of $4 million on 1953. The United Kingdom's share was nearly $51 million. Other participants in order of importance were the Netherlands ($6,166,000), West Germany ($3,377,000), the U.S.A. ($3,349,000), Japan, Australia and Hong Kong. The following table shows the values of the chief groups in 1954 with notes of increases or decreases compared with 1953. It will be seen that while imports of wires and cables declined as a whole, the United Kingdom maintained her predominant position. On the other hand, in the increased trade in radio and television receiving sets the Netherlands benefited as also did West Germany (to a small degree) but the United Kingdom lost ground. (Malayan dollar=2s 4d.)

Class of Equipment	1954 Malayan $ (000)	Inc. or dec. on 1953 Malayan $ (000)
Convertors and transformers	1,896	− 225
From U.K.	1,753	+ 11
Generators	1,339	− 4,225
From U.K.	1,092	− 4,095
Motors 25 h.p. and under	717	− 212
From U.K.	646	− 195
,, *U.S.A.*	28	+ 6
Motors 25 h.p. to 100 h.p.	390	− 311
From U.K.	376	− 195
Motors over 100 h.p.	534	+ 206
From U.K.	525	+ 252
Switchgear	2,931	+ 1,201
From U.K.	2,922	+ 1,201
Automobile lamp bulbs etc.	189	+ 102
From U.K.	153	+ 86
,, *Japan*	25	+ 25
Flash, radio panel and cycle dynamo bulbs	557	+ 321
From Hong Kong	143	+ 68
,, *West Germany*	110	+ 110
,, *Netherlands*	161	+ 38
,, *U.S.A.*	55	+ 30
,, *Japan*	75	+ 75
Fluorescent lamps, not h.v.	336	+ 95
From U.K.	158	+ 35
,, *U.S.A.*	116	+ 26
,, *Netherlands*	47	+ 22
Wires and cables not telegraph or telephone, rubber insulated	6,165	+ 578
From U.K.	5,797	+ 501
Ditto, insulation other than rubber	2,500	− 3,356
From U.K.	2,241	− 3,536
Ditto, telegraph and telephone (submarine)	2,892*	+ 2,468
Other wires and cables	821*	− 1,145
Electric supply meters	1,449*	+ 911
Other electric meters	122	− 207
From U.K.	112	− 209
Electric refrigerators	4,407	†
From U.K.	1,821	†
,, *U.S.A.*	2,143	†
Fans, ceiling	2,262	− 240
From U.K.	1,897	− 138
,, *India*	251	− 201
Fans, table	593	− 296
From U.K.	261	− 245
,, *Japan*	212	− 42
Other electric fans	197	− 39
From U.K.	115	− 54
,, *Netherlands*	49	+ 14
Flat irons	547	+ 179
From U.K.	504	+ 147
Accumulators	2,919	+ 502
From U.K.	2,146	+ 494
,, *West Germany*	280	− 49
,, *Australia*	454	+ 42
Batteries, torch	1,282	+ 40
From U.K.	345	− 256
,, *Hong Kong*	643	+ 412
,, *U.S.A.*	293	− 72
Other batteries	857	+ 248
From U.K.	777	+ 202
,, *India*	48	+ 48
Transmitters and radio communication apparatus, including radar, excluding valves	1,708	− 386
From U.K.	1,201	− 690
,, *Australia*	368	+ 368
,, *U.S.A.*	117	+ 1
Transmitting and industrial valves	254	− 17
From U.K.	200	− 46
Other valves	236	− 44
From U.K.	122	− 24
,, *Netherlands*	95	− 17
Telephone and telegraph apparatus	5,666	− 512
From U.K.	5,637	− 430
Radio and television receiving sets	4,684	+ 1,065
From Netherlands	3,336	+ 1,197
,, *U.K.*	791	− 381
,, *West Germany*	511	+ 2,553
Cooking and heating apparatus	2,122	+ 45
From U.K.	1,968	+ 39
,, *West Germany*	37	+ 22
Electric lamp bulbs	1,387	+ 211
From U.K.	888	+ 69
,, *Netherlands*	438	+ 108
Electro-medical apparatus, X-ray and vacuum tubes	255	− 182
From U.K.	126	− 65
,, *Netherlands*	48	− 64

* All or mainly from U.K.
† Comparative figures not available.

MARTINDALE

The long thin insulated nozzle makes it possible to blow out dust from the most awkward corners of electrical switchgear, motors, electronic equipment and other plant, even when "alive." A selection of five machines of various sizes is available to cover all kinds of work where either a blower or a portable vacuum cleaner is required.

Martindale Hot Air Blowers, in powers from 500 — 3,000 watts, are ideal for the quick drying of windings of all kinds before and after varnishing, and for many other purposes connected with the electrical industry. Can be used with the heat off as blowers for dust removal and vacuum cleaning.

Martindale Portable Blowers are of first-class construction and guaranteed for a year against faulty workmanship. Supplies from stock.

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FOR ALL FORMS OF CONTINUOUS PROCESS PLANT

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Infinitely Variable Output Speed.

Speed controls adjustable with drive running or stationary.

Hand, Electric remote, or Automatic Speed Controls.

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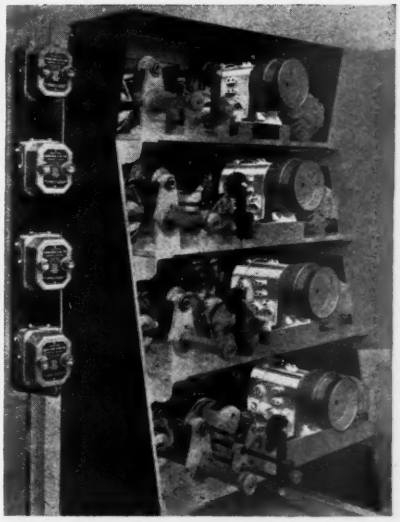

Right: Fine wire-tinning plant built by Mr. S. C. MEREDITH. Illustration shows four variable speed capstans.

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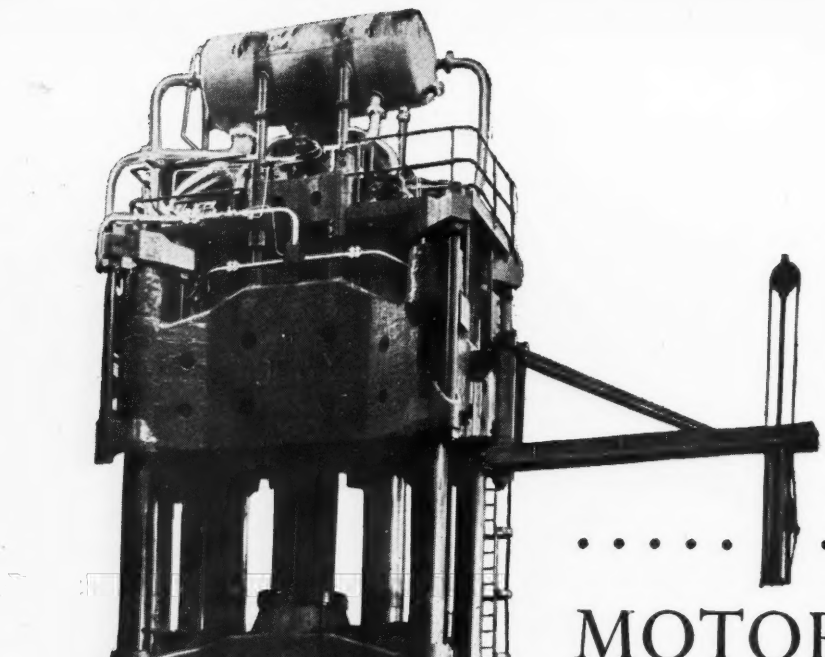

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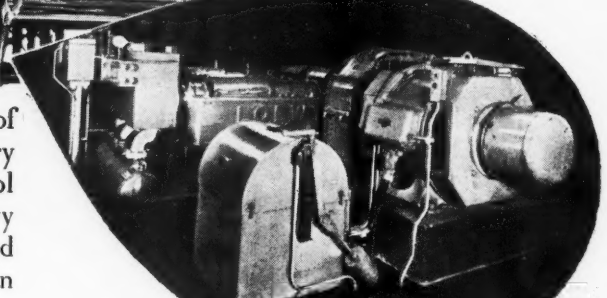
MOTORS and CONTROL GEAR by METROVICK



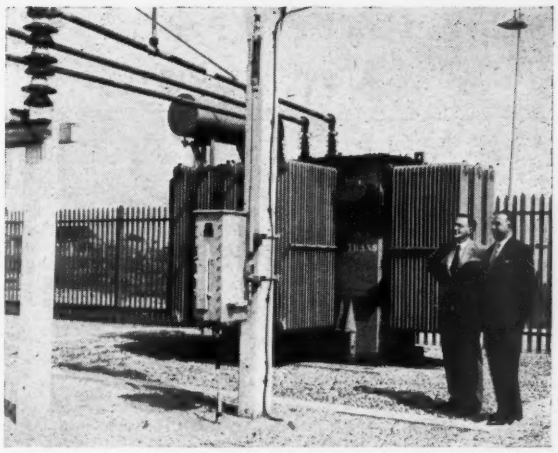
For maximum reliability and ease of maintenance, leading plant and machinery manufacturers choose motors and control gear by Metrovick. This 2,700 ton Loewy hydraulic press, for example, is powered from an air hydraulic accumulator station with five pumps each driven by a Metrovick 550 hp type RW slipring motor. The type R series of squirrel cage and slipring motors extends from 35 to 3,000 hp. Various types of enclosures are available including screen protected, drip-proof, totally enclosed with pipe ventilation, or totally enclosed with fan cooling. Write for descriptive literature dealing with your particular interest.

One of five 550 hp 730 rpm screen protected 3·3kV type RW slipring motors with type LF liquid rotor starter driving a Loewy high pressure hydraulic pump for use with hydraulic presses at Hadfields East Hecla Works, Sheffield.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER 17

J/A 301

GENERATION AND DEVELOPMENT



The Governor of Baghdad (right) and Mr. R. E. Atkins, Norwich district manager, Eastern Electricity Board, inspecting the 33 kV substation at Wroxham

Governor of Baghdad at Norwich

His Excellency Abdul Jabbar Fahmy Beq, C.B.E., the Mutisarrif of Baghdad, who has been visiting this country as the guest of the British Council, chiefly to study certain aspects of local administration, is interested in problems of rural electrification and spent 5th August visiting electrical installations in the Norwich District of the Eastern Electricity Board accompanied by the Norwich district manager, Mr. R. E. Atkins. His Excellency inspected a major 33 kV substation at Wroxham where he also saw a typical rural electricity service centre with offices and stores. A demonstration was given of the recently installed "talk-through" radio facilities used to speed up the restoration of supplies with the aid of radio equipped vans. The visit also included a canning factory in North Walsham and a fully electrified farm at Woodbastwick where electricity is used for grain drying and conveying, steam raising, milking, water pumping, etc.

Reinforcement of Supply to Ayr

The South of Scotland Electricity Board has approved a scheme for the reinforcement of supply to the southern part of Ayr. Seven substations will be changed over from 3·3 kV to 11 kV working and the existing switchgear arrangements at two further substations will be modified. The work also involves the laying of 3,575 yd of h.v. cable and 250 yd of l.v. cable. The scheme will cost £26,600 and is a continuation of the reinforcement of supply to Ayr which has been in progress for some time.

More South Wales Farms Connected

Some facts about the progress of rural electrification in South Wales were given by Mr. W. A. Gallon, deputy chairman of the Board, at the Royal Welsh Show, Haverfordwest. Last year, he said, 1,311 farms had been added to the system, bringing the total number served to 6,768 In the three months to the end of June 301 had been connected against 209 in the same quarter of 1954 and the Board expected to finish 1955-56 with a figure somewhere near 2,000. In South Wales there were 25,000 farms of which 3,500 were so inaccessible that it was unlikely they would ever be supplied with electricity. About 14,000 of the remaining 21,500 farms had still to be connected, and at the present rate farm electrification might be completed in less than eleven years.

Mr. Gallon said that in the year ended 31st March the average farm consumption was 3,608 kWh, and although it was not a lot it was better than last year when farms used on an average 3,440 kWh. The uses to which electricity could be put on the farm were so many and so various that the 3,608 kWh per farm could be materially increased.

Australian Plant Capacity

The total installed capacity of the interconnected systems of the Australian States rose by some 490 MW to 3,122 MW during the year ended 30th June, 1954. Despite the substantial increase in electricity consumption, this was sufficient to meet the demand and restrictions on the use of power which had been in force in New South Wales, Victoria and Queensland were largely withdrawn. It is still necessary, however, to build up an adequate reserve of plant capacity.

At 30th June last New South Wales had the largest installed capacity, viz., 1,207 MW, followed by Victoria, 814 MW; Queensland, 378 MW; Tasmania, 312 MW; South Australia, 237 MW; Western Australia, 165 MW; and Australian Capital Territory, 8·8 MW. Of the total plant installed 81 per cent consisted of thermal plant, 12 per cent being hydro-electric and 7 per cent i.c. engine driven. Work was in progress on projects totalling 2,204 MW, including the following (in MW):—

New South Wales: Pyrmont "B," 200; Lake Macquarie, 330; Lake Illawarra, 120; Wallerwang 120; and Balmain, 75.

Victoria: Yallourn "C," 106; Yallourn "D," 100; Kiewa (stage 2), hydro, 62; and Eildon, hydro, 135.

Queensland: Bulimba, 120; Tennyson, 120; Tully Falls, hydro, 72; and Maryborough, Rockhampton and Townsville, 15 each.

South Australia: Port Augusta, 90; and Osborne "B," 60.

Western Australia: Bunbury, 90; and South Fremantle, 100.

Tasmania: Tungatinah, 125; Trevallyn, 80; Lake Echo, 32; and Wayatinah, 128 (all hydro).

In addition, various projects in New South Wales, Victoria, South Australia and Western Australia will add about 261 MW. The Snowy Mountains hydro-electric project is not included in the above survey.

Irish Board's Finances

Withdrawal of the rural electrification subsidy in Ireland should not result in any increase in electricity charges, said the Minister for Industry and Commerce, Mr. W. Norton, in the Dail recently. He pointed out that with the exception of one year, when there were unprecedented causes, the Electricity Supply Board had made surpluses each year. This year the surplus was the biggest in its history. Rural electrification would be accelerated this year and next and there was no reason why the taxpayer should be asked to subsidize the E.S.B. any longer.

Improved Douglas Finances

Compared with a loss in the previous year, there was a net profit of £4,620 on the 1954-55 year's working of the Douglas (I.O.M.) electricity undertaking. In his report the borough electrical engineer and manager (Mr. C. Anderson) shows that income from the sale of electricity rose by £26,744 while there was a reduction in operating costs, excluding fuel, of £758. The accounts do not include the £63,000 awarded to the Corporation by the arbitrator in respect of the discontinuance of purchase of electricity by the Isle of Man Electricity Board. In the Douglas area 21·9 million kWh was sold at an average price of 2·635d/kWh (against 2·443d in 1953-54). Domestic appliances on hire increased in number from 7,804 to 8,186. The Corporation's power station's output was 24·6 million kWh, the capacity remaining unchanged at 11,725 kW.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 21st September from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

4304. Cinema-Television, Ltd.—Electron discharge tubes. 22nd February, 1952. (737162.)

16359. English Electric Valve Co., Ltd.—Discharge tubes. 21st March, 1952. (737168.)

1952

1293. Marconi's Wireless Telegraph Co., Ltd.—Television systems. 11th December, 1952. (737171.)

3155. Loewe Opta Akt.-Ges.—Electro system for electron-ray tubes. 6th February, 1952. (736995.)

14221. Leland Stanford Junior University, Board of Trustees of.—High frequency electron discharge devices. 5th June, 1952. (736996.)

17475. Automatic Telephone & Electric Co., Ltd.—Methods of mounting small electrical components having connecting wires. 23rd June, 1953. (737095.)

21545. Standard Telephones & Cables, Ltd.—Electric pulse repeating circuits using a gaseous discharge device. 27th August, 1952. (736999.)

24455. Raytheon Manufacturing Co.—Reflex velocity modulated electron discharge devices. 30th September, 1952. (737001.)

26459. National Research Development Corporation.—Travelling-wave linear particle accelerators. 21st October, 1953. (737098.)

26747. Reyrolle & Co., Ltd., A.—Electric relay devices. 16th October, 1953. (737273.)

28300. English Electric Co., Ltd.—Decking apparatus for mine installations. 6th November, 1953. (737274.)

29122. Westminster Films, Ltd.—Kinematograph or television cameras. 18th November, 1953. (737275.)

30369. Foster Transformers, Ltd., and Bagnall, R. I.—Electrically operated time delay overload responsive devices. 1st December, 1953. (737320.)

32000. Philips Electrical Industries, Ltd.—Medical X-ray apparatus. 17th December, 1952. (737190.)

32676. Babcock & Wilcox, Ltd.—Tubulous vapour generating and vapour heating units. 18th December, 1953. (737200.)

33006. Owens-Corning Fiberglas Corporation.—Electrically heated glass melting furnace. 30th December, 1952. (737108.)

1953

1112. British Thomson-Houston Co., Ltd.—Shaft bearings. 14th January, 1953. (737113.)

1182. Electric & Musical Industries, Ltd.—Magnetic transducing heads. 14th January, 1954. (737323.)

1262. Stone & Co. (Deptford), Ltd., J.—Control of the charging of electric batteries. 6th January, 1954. (737008.)

1495. General Electric Co.—Thermal control systems. 19th January, 1953. (737324.)

3584. Egyesult Izzolampa Es Villamossagi R. T.—Air tight sealing of the base and bulb of radio tubes of small size and a radio tube produced by this process, particularly a radio tube with a guide cam. 9th February, 1953. (737013.)

3904. Standard Coil Products Co., Inc.—Television tuners for receiving v.h.f. and u.h.f. channels. 11th February, 1953. (737285.)

4244. Chambers, D.—Blocking oscillator circuit arrangements for producing variations impulse duration. 12th February, 1954. (737119.)

4998. Svenska Aktiebolaget Gasaccumulator.—Speaking radio beacons. 23rd February, 1953. (737017.) 5542. Antenna systems more especially for use with speaking radio beacons. 27th February, 1953. (737019.)

8395. General Electric Co., Ltd.—Terminal assemblies for sealed electrical devices. 26th March, 1954. (737205.)

8531. Western Electric Co., Inc.—Electron-discharge devices utilizing travelling waves. 27th March, 1953. (737289.)

8559. Siemens & Halske Akt.-Ges.—Method of and circuit arrangement for the receiving of telegraphic signals in carrier current telegraph installations. 27th March, 1953. (737206.)

9395. Philips Electrical Industries, Ltd.—Contact members for use with disc-seal and like discharge tubes. 7th April, 1953. (737027).

9666. General Electric Co.—Insulated portable shelters. 9th April, 1953. (737132.)

10054. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for cutting materials. 26th March, 1954. (737029.)

10164. Philips Electrical Industries, Ltd.—Cathode-ray tubes for reproducing coloured television images. 14th April, 1953. (737030.)

10185. Soc. des Accumulateurs Fixés et de Traction.—Negative electrodes for alkaline storage batteries. 14th April, 1953. (737290.)

10433. General Electric Co., Ltd., and Williams, C. E.—Electric circuit arrangements for starting and operating gas and/or vapour filled electric discharge devices. 30th March, 1954. (737031.)

10514. Revo Electric Co., Ltd.—Means for lagging ovens of gas or electric cookers. 12th April, 1954. (737331.)

10994. Gretener, E.—Apparatus for the transmission and reproduction of colour television images. 21st April, 1953. (737212.)

11631. Air Trainers, Ltd.—Potentiometers and rheostats. 27th April, 1954. (737332.)

12658. Eutectic Welding Alloys Co., Ltd.—Electric arc heating tool. 6th May, 1953. (737037.)

12894/5/6. Mullard Radio Valve Co., Ltd.—Voltage stabilizer circuit arrangements. 8th May, 1953. (737292/3/4.)

14492. Philips Electrical Industries, Ltd.—Multiplex television systems. 22nd May, 1953. (737136.)

15272. Soc. Anon. de Télécommunications.—Equipment for amplifier stations for long distance telephone lines. 1st June, 1953. (737221.)

18954. Eicken, H.—Apparatus for defining the percentage of moisture contained in relatively electrically non-conducting materials. 8th July, 1953. (737145.)

19588. Menzel, F.—Seasonal control means for charging electric storage batteries. 14th July, 1953. (737343.)

20058. General Electric Co.—Arc discharge tube ballast transformers and circuits therefor. 20th July, 1953. (737048.)

20771. Philips Electrical Industries, Ltd.—Electric-discharge tubes. 27th July, 1953. (737300.)

22456. Teletype Corporation.—Apparatus for transmitting signals recorded on a control form or tape. 14th August, 1953. (737149.)

23119. Crypto, Ltd., and Wilson, E. P.—Drying devices. 2nd July, 1954. (737054.)

23401. Compagnie Industrielle des Téléphones.—Sensitive polarized electric relay. 25th August, 1953. (737301.)

23624. Sylvania Electric Products, Inc.—Colour television signal generator. 26th August, 1953. (737351.)

24314. Württembergische Metallwarenfabrik.—Method of manufacturing heating conductors for electric heating apparatus. 2nd September, 1953. (737058.)

24496. Coates, C., Gray, C. H., and Small, C. J. P.—Electromagnetic transducers. 4th September, 1953. (737239.)

25834. English Electric Co., Ltd.—Fuel injection pumps for internal combustion engines. 15th April, 1954. (737356.)

26219. Aircraft-Marine Products, Inc.—Method and apparatus for making an electrical connection. 23rd September, 1953. (737150.)

26254. Babcock & Wilcox, Ltd.—Hopper bottom pulverized fuel fired furnaces. 23rd September, 1953. (737151.)

28074. Hellefors Bruks Aktiebolag.—Method of electrically heating metal blanks for rolling or forging. 12th October, 1953. (737305.)

30925. Air Preheater Corporation.—Apparatus for cleaning a bank of tubular elements, especially of electrostatic precipitators. 9th November, 1953. (737362.)

31423. Radio-Industrie.—Colour television systems. 12th November, 1953. (737156.)

31961. Western Electric Co., Inc.—Electric signal translating circuits employing transistors. 18th November, 1953. (737249.)

31963. Bays, F.—Electric switches and assemblies thereof. 18th November, 1953. (727250.)

32031. Lignes Télégraphiques et Téléphoniques.—Manufacture of magnetic cores. 18th November, 1953. (737068.)

32880. General Electric Co.—Apparatus for measuring direct current. 26th November, 1953. (737307.)

34799. Negretti & Zambra, Ltd.—Electric apparatus for indicating the condition of a variable. 14th December, 1953. (737077.)

35489. Research Corporation.—Recovery of fly ash by electrostatic precipitation. 21st December, 1953. (737368.)

1954

18972. Automatic Telephone & Electric Co., Ltd.—Mounting arrangements for electrical components. 23rd June, 1953. (737160.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 27th August:

TRANOCEANIC. No. 726,745, Class 9. Radio receiving and transmitting apparatus and apparatus for amplifying sound; television receiving and transmitting apparatus; radiogramophones; electronic discharge tubes (not for lighting purposes); electric storage batteries; microphones; radio aerials, etc.—Zenith Radio Corporation, Chicago, Ill., U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, London, W.C.2.

MAGNA. No. 739,978, Class 9. Electrically ignited cigar and cigarette lighters and parts.—Magnatex, Ltd., Harlington Works, Bath Road, Harlington, Middx.

SERENADE. No. 741,162, Class 9. Radio sets, television sets, gramophones and talking machines.—Mohamad Husain Ismail, 90, Judd Street, London, W.C.1.

DISTROLITE. No. 741,648, Class 11. Fluorescent lighting fittings.—Frankland Crumblehulm, Spring Lawn Cottage, Chorley New Road, Heaton, Bolton, Lancs.

PEVIC. No. 739,223, Class 16. Identification sleeves for marking electric cables and electrical connections; and labels and adhesive materials (stationery).—Wireless Telephone Co., Ltd., Hallamsgate Works, Crookes Road, Sheffield, 10.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Bilston.—9th September. Borough Council. Lamps for street lighting. Borough engineer, 20, Wellington Road.

Cambridge.—10th September. City Council. Supply of electric lamps (schedule 2), for one year from 1st October. City engineer, Guildhall.

Carlisle.—5th September. City Council. Electrical installations in 252 dwellings. City surveyor, 18, Fisher Street.

East Riding.—29th August. County Council. Electrical installation in a county secondary school at Pocklington. J. H. Napper, architect, 56, Eldon Place, Newcastle-on-Tyne, 1.

Formosa.—29th August. Central Trust of China, U.S. Aid Division, Taipei. 2,000 kVA and 3,000 kVA transformer, switchgear, cables, lightning arrestors, etc. 1st September. Two 1,500 kW steam turbine generators. (E.S.B. 16141/55. Ten/14916.)*

Hereford.—5th September. City Council. Street lighting equipment. (See this issue.)

India.—19th September. Damodar Valley Corporation. Core/shell type power transformers for Eastern Railways. (E.S.B. 16383/55. Ten/14914.)*

Iran.—24th September. Ministry of Posts, Telegraphs and Telephones. 100 kW short wave transmitter, receivers, transformers, cables, etc. (E.S.B. 16737/55. Ten/14995.)*

Irish Republic.—2nd September. Arklow U.D.C. Electrically-operated pumping unit. (E.S.B. 16824/55. Ten/15017.)*

Islington.—Borough Council. Provision, fixing, replacement and repair of lantern lights. Town Clerk, Town Hall, Upper Street, London, N.1.

King's Lynn.—29th August. Borough Council. Street lighting equipment. H. G. Ridler, borough engineer, Clifton House, 17, Queen Street.

Kingston-on-Thames. — 19th September. Borough Council. Six sets of electrically-driven, vertical, unchokeable sewage pumps and equipment, main drainage contract No. 4. John Taylor & Sons, engineers, Artillery House, Artillery Row, Westminster, S.W.1.

Mitcham.—10th September. Borough Council. Street lighting equipment. (See this issue.)

New Biggin (Northumberland).—30th August. U.D.C. Electrical installations in 26 houses at Bull Field. Surveyor, Council Offices.

New Zealand.—26th August. Electricity Department, Wellington City Council. H.v. and l.v. pilot cable and joint boxes. (E.S.B. 16736/55. Ten/14984.)*

29th August. Electricity Department, Dunedin City Corporation. Bare, p.v.c. insulated, a.c.s.r., cambric insulated and lead sheathed cables. (E.S.B. 16834/55. Ten/15024.)*

25th September. State Hydro-Electric Department. 30,000 kVAr, 11 kV shunt reactor. (E.S.B. 16703/55. Ten/14977.)*

Pakistan.—7th September. Posts and Telegraphs Department. Telegraph material and accessories. (E.S.B. 16434/55. Ten/14923.)*

Philippines.—25th August. National Economic Council, Manila. Equipment for thermodynamics, electronics and communications engineering laboratories. 30th August. Equipment for electrical, physics and chemistry laboratories. (E.S.B. 16543/55. Ten/14933.)*

Portuguese East Africa.—24th August. Posts, Telegraphs and Telephone Department, Lourenço Marques. Telephone material. (E.S.B. 16270/55. Ten/15042.)*

14th September. Ports, Railways and Transport Department, Lourenço Marques. Electrical equipment including tubing, lamps, plugs, wire, switches, circuit-breakers, etc. (E.S.B. 16435/55. Ten/14904.)*

Rhodesia and Nyasaland.—2nd September. Controller of Stores and Transport. Diesel generators. (E.S.B. 16394/55. Ten/14906.)*

South Africa.—31st August. Stores Department, South African Railways. Cable. (E.S.B. 16310/55. Ten/14921.)* 2nd September. Two electric horizontal box type furnaces. (E.S.B. 16574/55. Ten/14943.)* 7th September. 300 kVA, 11 kV transformer. (E.S.B. 16690/55. Ten/15005.)*

1st September. Union Supplies and Tender Board. Fifty transmitter receivers for the South African Navy. (E.S.B. 16775/55. Ten/15001.)* Diesel-electric alternators. (E.S.B. 16773/55. Ten/14999.)*

Uruguay.—13th September. Usinas Electricas y los Telefonos del Estado, Montevideo. Transformers and spare materials. (E.S.B. 16432/55. Ten/14952.)*

Wirral.—10th September. U.D.C. Street lighting equipment. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 Chancery 4411; extension 769).

ORDERS PLACED

Durham.—R.D.C. Supply of electrical materials for 180 houses:—Electrical fittings, fires and cables.—"Z" Electric Lamps and Supplies. Washboilers.—S. Gratrix and Co.

Longbenton (Northumberland).—U.D.C. Electrical installations in 30 houses on the Fordley estate.—Forest Electrics, Palmersville.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Showrooms and offices, 153-55, High Street; Boots Pure Drug Co., Ltd., Station Street, Nottingham.

Bank on trading estate; Barclays Bank, Ltd., Head Office, 54, Lombard Street, London, E.C.3.

Barrow-in-Furness.—New branch premises for the Barrow Co-operative Society, Ltd.; C.W.S., Ltd., Building Department, Vere Street, Salford.

Bedford.—36 flats, Monkhill, Putnoe estate, and 53 maisonnettes, Beauchamp Row; borough surveyor.

Billingham-on-Tees. — Workshops for British Titan Products, Ltd., Kronos House, Coppergate, York.

Bilston. — Factory extensions, Oxford Street, for Onions & Sons, Ltd., welders, Weldonia, Moxley Road; McKewan & McKewan, architects, 318, Hamstead Road, Birmingham, 20.

Birmingham.—Twin operating theatres, Selly Oak Hospital; Birmingham Regional Hospital Board, 10, Augustus Road, Edgbaston.

Secondary schools for boys and girls at West Heath, for E.C.; A. G. Sheppard Fidler, city architect, Civic Centre.

Brighton.—Entertainments centre on sea front (£160,500); D. J. Howe, borough surveyor, King's Road.

Cardiff.—Dwellings (97), Llanrumney estate; city surveyor.

Coventry.—Works and offices, Torrington Avenue; G. W. Deeley, 27, Avon Street.

Darlington.—Orthopædic wards with operating theatres at Darlington Memorial Hospital for Newcastle Hospital Board, Benfield Road, Newcastle-on-Tyne.

Derby.—Factory for Platers & Stampers, Ltd.; Elliott Cox & Partners, architects, Coastal Chambers, 172, Buckingham Palace Road, London, S.W.1.

Durham.—Family group homes at Bishop Auckland, Stanley, Sedgefield, Stockton and Chester-le-Street; county architect, Court Lane.

Ealing.—Flats (36), Fairview estate; 26 old persons' bungalows on the Dibden House site; public hall at Greenford; slipper baths at South Ealing (£21,000); C. W. Seddon, borough surveyor, Town Hall, W.5.

Enfield.—Showrooms and offices; Chaseside Motors, Ltd., Great Cambridge Road.

Essex.—Branch libraries at Harold Wood, Hornchurch and Romford and ambulance station at Ilford; H. Conolly, county architect, County Hall, Chelmsford.

Eston.—R.C. school (£32,186); county architect, County Hall, Northallerton.

Exeter.—Infants' school, Whipton estate, and 36 dwellings, Baughan Road; city architect.

Gateshead.—Crematorium at Low Fell; G. S. Winters, borough surveyor.

Gosport.—Church and hall, Prideaux Avenue; Clayton & Black & Partners, architects, 25, Landport Terrace.

Grimsby.—Western Secondary Modern Girls' School (£150,000), Little Coates Road; borough architect.

Hampshire.—Robert May School at Odiham, county junior school at Fawley, county mixed and junior schools on sites at Havant; workshops, stores, houses, etc., for ambulance staff at Amery House, Alton; county architect, The Castle, Winchester.

Harlow.—Shops and offices, New Town; Ravenseft Properties, Ltd., 52, Charles Street, London, W.1.

Haydock.—Factory for Thos. Crompton & Sons, Ltd.; G. & J. Seddon, Ltd., Little Hulton, Nr. Bolton.

Hendon.—Rebuilding and extensions, Ajax Avenue, for Tilley Lamp Co., Ltd., 15, Sackville Street, London, W.1; R. C. N. Golding, architect, 11, Windmill Street, London, W.1.

Flats (352), Spur Road; borough engineer.

Hereford.—Houses (102), on the Ross Road site, for Housing Committee; borough engineer, Town Hall.

Hove.—R.C. church, Court Farm Road, Hangleton; D. Plaskett Marshall, architect, 59, Gordon Square, London, W.C.1.

Huddersfield.—Houses (106), on estate at Mold Green; borough architect, High Street Buildings.

Hyde.—Houses (55), Donald Avenue; borough surveyor.

Works extensions; E. Peart & Co., Ltd., Simpson Street.

Leicester.—Special school at Glenfield Road (£37,500); J. H. Lloyd Owen, city architect, 7, Newarke Street.

Liverpool.—Large extensions and improvements to premises for Peter Walker Cain, Ltd., Duke Street; own staff.

London. — Church, Holborn Viaduct; Albert J. Thomas, architect, 31a, Sloane Street, S.W.1.

Office block, Minories; Venture Property & Development Co., Ltd., 3, Buckingham Palace Gardens, S.W.1.

Ward block for St. Bartholomew's Hospital, Smithfield; James Carmichael, Ltd., contractors, 331, Trinity Road, S.W.18.

Office building, Goodge Street and Charlotte Street, St. Pancras; Newman, Levinson & Partners, architects, 9, Mansfield Street, W.1.

Four 11-storey blocks of flats at Hobbs Place, St. Mary's estate and Wenlock Barn estate, Shoreditch; T. L. Sharratt, borough engineer, Town Hall, Old Street, E.C.1.

Luton.—Office block, Leicester Road; Alcock (Peroxide), Ltd., chemicals, Chaul End Lane.

Maidstone.—Offices and extensions to printing works, Straw Mill Hill; Alabaster Passmore & Sons, Ltd., printers, Tovil.

Manchester.—Erection of kitchen/dining rooms at Old Moat Schools, Withington; Brookdale Park Schools, Newton Heath, and at Webster Street School, Greenheys; new buildings for North Manchester High School for Girls (£238,390); L. C. Howitt, city architect, Town Hall.

Mitcham.—Factory; Hancock, Corfield & Waller, Ltd., Trafalgar Works, Station Road, London, S.W.19.

Newcastle-on-Tyne.—Primary school at North Kenton for the E.C.; city architect, 18, Cloth Market.

Newport (Mon).—Assembly hall block at the Civic Centre; T. Cecil Howitt, architect, St. Andrew's House, Mansfield Road, Nottingham.

Oxford.—Dining hall, library and common rooms for Nuffield College; Benfield & Loxley, Ltd., builders, 106, Bullingdon Road.

Penrith.—Houses (100), Milner Mount; Thomas Armstrong, Ltd., builders, Brigham, Cockermouth.

Plymouth.—Dwellings (42) and shops (34), Pannier market scheme; J. Paton Watson, borough surveyor, Guildhall.

Pocklington.—County secondary school with houses for headmaster, caretaker, etc. (£172,349); county architect, County Hall, Beverley.

Portsmouth.—Ice stadium, etc., Western Road, Wymering; Figgins & Sons, Ltd., The Lodge, Lower Road, Bedhampton.

Prestwich.—Civic hall at the Bury New Road/Hilton Lane site (£50,000); C. A. Cross, town clerk, Town Hall.

Reading.—Mid-South Secondary School for Girls; Howard V. Lobb & Partners, architects, 20, Gower Street, London, W.C.1.

Redcar.—Secondary school; county architect, County Hall, Northallerton.

Seaham.—Factory, Dene House Road; John Barran & Sons, Ltd., clothiers, Team Valley Trading Estate, Gateshead.

Sheffield.—Church of William Temple at Harborough Avenue; J. Mansell Jenkinson & Son, architects, 18, Norfolk Row.

South Shields.—New wings and assembly hall, Marine and Technical College; and buildings in the Market Place for the T.C., on behalf of the Ministry of Works (£20,000); John Reid, borough engineer.

Stanley (Co. Durham).—Houses (103), Catchgate, for U.D.C.; Thomas Armstrong, Ltd., builders, Cockermouth, Cumberland.

Stockton-on-Tees.—General engineering workshops, offices and storage buildings, Church Road, for Hugill Forge Co.; Jackson and Edmonds, architects, Colmore Row, Birmingham.

Workshops and offices, Adam Street, for Readymixed Concrete, Ltd., Readymix House, London, S.W.1.

Extensions to children's hospital; Cleveland Hospital Management Committee, Middlesbrough.

Stoke Newington.—Houses (125), on the Lordship Road re-development area; borough surveyor, Church Street, N.16.

Thornaby-on-Tees. — Houses (139), at Village Green; J. L. Watson, borough engineer.

Tynemouth.—Factory, North Shields, for Major Equipment, Ltd.; L. G. Wood, architect, 17a, Northumberland Square, North Shields.

Houses (44), Redburn View; borough engineer, 16, Northumberland Square, North Shields.

Wakefield.—Dwellings (272), Kettlethorpe estate; city engineer.

Wallsend.—Additions to the Civic Hall for the T.C. (£20,000); T. Clements and Son, builders, Jesmond, Newcastle-on-Tyne.

Nurses' training school and hostel; Newcastle-on-Tyne Regional Hospital Board, Osborne Road, Newcastle.

Welwyn Garden City.—Houses (97), Howicks Green; Charles W. Fox, architect, 22, Parkway.

West Bromwich.—Works and offices, Golds Hill; John Cashmore, Ltd., Eagle Works, Great Bridge, Tipton.

Factory and offices at Goldshill; Midland Motor Cylinder Co., Ltd., Dartmouth Road, Smethwick, 40.

West Drayton.—Secondary modern school; Middlesex county architect, 10, Great George Street, London, S.W.1.

Whickham (Co. Durham).—Houses (139), on the Whickham Hill estate; William Leech, Ltd., builders, 2, Clayton Street, Newcastle-on-Tyne.

Wigan.—Operating theatre, Billinge Hospital; Manchester Regional Hospital Board, Cheetwood Road, Manchester, 8.

Workington.—Training centre, Moss Bay (£35,000), for Workington Iron & Steel Co.; Johnston & Wright, architects, 13, Castle Street, Carlisle.

Worksop.—Public hall at Market Place; J. Haslam & Sons, architects, Ryton Chambers, Newcastle Avenue.

Yaxley.—Fire station; county architect, Huntingdon.

CATALOGUES AND LISTS

AIR AND DUST CONTROL.—Illustrated broadsheet on the "Aerflo" range of air and dust control equipment.—**Supervents, Ltd.**, Magnare House, Sidcup By-pass, Kent.

BRAZING ALLOYS.—Illustrated folder giving full details of "Easy-Flo" paint for certain brazing applications.—**Johnson, Matthey Co., Ltd.**, 73-83, Hatton Garden, London, E.C.1.

FLUID SEAL.—Leaflet introducing the new "Hallprene" patent fluid seal.—**Hall & Hall, Ltd.**, Oldfield Works, Hampton, Middlesex.

FLUORESCENT. — 14-page loose-leaf catalogue on "Parmar" auxiliary gear for the operation of fluorescent tubular discharge lamps.—**W. J. Parry & Co. (Nottingham), Ltd.**, Victoria Mills, Draycot, Derbyshire.

INSTRUMENTS AND CONTROLS.—Two technical catalogues dealing with Bailey miniature equipment for temperature flow, pressure level, draught, etc. (E.500) and transmitters for flow, pressure, level, gas analysis, etc. (E.231).—**Bailey Meters and Controls, Ltd.**, Purley Way, Croydon.

Eight illustrated technical folders on recording and indicating instruments dealing with the KUP flow and pressure recorder (362), KUX differential pressure recorder (363), KUE flow transmitter (366), KR receiver recorder (372), KUS flow indicator (364), KT temperature recorder (374), KRX receiver recorder (373), and Kent boiler test indicator (365).—**George Kent, Ltd.**, Luton, Beds.

Illustrated catalogue on the "Hagan" three-element feed water control (H54).—**James Gordon & Co., Ltd.**, Dalston Gardens, Stanmore, Middlesex.

Technical folder illustrating the Smiths range of hand tachometers.—**Smiths Industrial Instruments, Ltd.**, North Circular Road, London, N.W.2.

INSULATION.—Illustrated, priced catalogue dealing with the "Plansel" binding system for the marking, binding and insulating of cables and wires.—**Creators, Ltd.**, Sheerwater, Woking.

METALS.—44-page booklet containing details of many new applications of "Meehanite" metals and castings.—**International Meehanite Metal Co., Ltd.**, Meerion House, 4, Downside, Epsom, Surrey.

Illustrated brochure listing the wide range of "Expamet" expanded aluminium, together with an index of some of its uses.—**Expanded Metal Co., Ltd.**, Burwood House, Caxton Street, London, S.W.1.

OVERHEAD BUSBAR EQUIPMENT.—Four folders on the "Miniplug" distribution duct for lighting and small power installations; "Minibus" miniature busbar distribution system; "Uniduct" trolley feed rail and "Trollyduct" feed rail.—**E.M.S. Electrical Products, Ltd.**, 28/32, The Butts, Coventry.

REFRIGERATION.—Illustrated broadsheet containing comprehensive information on the "Prestcold" range of models and equipment (Z.201/1).—**Pressed Steel Co., Ltd.**, Cowley, Oxford.

Illustrated brochure covering the "Coldrator" VF.54 home freezer and the CS.71 domestic refrigerator.—**Coldrator Division, Hotpoint Electric Appliance Co., Ltd.**, Peterborough.

SWITCHES.—36-page illustrated priced catalogue of the company's range of switches and signal lamps (129).—**Arcolectric Switches, Ltd.**, Central Avenue, West Molesey, Surrey.

Power Supply in Madras

The Electricity Department of the Madras Government has prepared schemes estimated to cost nearly Rs750 million for inclusion in the second five-year plan. The Khunda project is among the major schemes proposed to be included and others provide for power plant extensions at Mettur, Pykara, Moyar and Papanasam and Madras City. Most of the electricity schemes under the first five-year plan are nearing completion.

New Zealand Imports

In New Zealand's imports of electrical goods last year there was a small decline in value compared with 1953. The accompanying table gives the values of the principal groups, totalling £10,600,000, with notes of increases and decreases. It will be seen that while imports of generators rose by about one-half, those of motors fell by one-third. Cables and wire figured as the most important item although one-third less than in the previous year.

Class of Equipment	1954 £ (000)	Inc. or dec. on 1953 £ (000)
Batteries and cells	126	+ 5
Electrodes and carbons ...	83	+ 21
Generators and magnetos ...	925	+ 325
Insulated cables and wire ...	1,645	− 808
Insulators and parts ...	129	− 15
Lamp bulbs	141	+ 18
Lamps (not surgical) ...	598	+ 158
Motors under 1 h.p. ...	318	− 194
,, 1 to 25 h.p. (inclusive)	168	− 114
,, exceeding 25 h.p. ...	36	− 84
,, parts, starters, etc.	271	− 9
Poles or towers, metal ...	9	− 15
Razors, electric	300	+ 94
Telegraphy and telephony (other than wireless) ...	1,216	− 330
Transformers and convertors	842	− 142
Other electrical apparatus...	2,769	+ 516
Valves for receiving sets ...	151	+ 53
Other wireless valves ...	50	+ 16
Other wireless apparatus ...	476	+ 34
Vacuum cleaners and parts...	311	+ 85